RECORD OF DECISION

Residential Property Soils - Operable Unit 01

Washington County Lead District - Richwoods Superfund Site

Washington County, Missouri

Prepared by:

U. S. Environmental Protection Agency
Region 7
901 North 5th Street
Kansas City, Kansas 66101

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Superfund

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RECORD OF DECISION

DECLARATION

SITE NAME AND LOCATION

Washington County Lead District - Richwoods Site
Operable Unit #01 (OU-1)
Washington County, Missouri
CERCLIS ID #: MON000705032

STATEMENT OF BASIS AND PURPOSE

This decision document for OU-1 presents the selected remedial action for lead-contaminated residential property soil at the Washington County Lead District - Richwoods Superfund Site (Site). This decision was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practicable, the National Contingency Plan. This decision is based on the Administrative Record for the Site. The Administrative Record is located at the following information repositories:

Richwoods R-VII Elementary School
10788 State Highway A
Richwoods, Missouri 63071

U.S. Environmental Protection Agency
Region 7
901 North 5th Street
Kansas City, Kansas 66101

The state of Missouri concurs with the Selected Remedy. State comments are presented and addressed in the attached Responsiveness Summary.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from OU1, if not addressed by implementing the response actions selected in this Record of Decision (ROD), present a current threat to public health, welfare, or the environment. Therefore, the response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. The Site contains heavy metals, primarily lead, in soil as a result of historical mining and processing.

DESCRIPTION OF THE SELECTED REMEDY

The U.S. Environmental Protection Agency (EPA) believes the Selected Remedy (Alternative 2 with an estimated present worth cost of approximately $2.23 million) appropriately addresses the principal current and potential risks to human health and the environment. The remedy addresses human health risks by the remediation of lead-contaminated residential property soil. The residential properties at the Site are being addressed by this ROD to expedite cleanup of the areas that pose the greatest and most immediate threats to human health. The major components of the selected remedy for the residential properties across Washington County include the following actions:

- Excavation, backfilling, and revegetation of lead-contaminated residential soil exceeding 400 parts per million lead at an estimated 79 residential properties;

- Health education for residents at the Site to support and raise public awareness, distribution of vacuum cleaners and exposure prevention information, coordination with area physicians of local families, and implementation of special projects to increase awareness of how local citizens can protect themselves from heavy metal health risks; and

- Institutional controls. This includes collaboration with interested citizens and local, county, state, and federal government officials to discuss and evaluate future institutional controls to safeguard future residential development and protect remediated residential properties from lead recontamination.

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with federal and state laws that are legally applicable or relevant and appropriate requirements for the remedial action, and is cost effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable but does not use treatment as a principal element because of the lack of demonstrated, effective treatment alternatives. Because the Selected Remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

Cecilia Tapia

Cecilia Tapia, Director
Superfund Division
U.S. EPA Region 7

9/29/11
Date

Record of Decision
Residential Property Surface Soil
Washington County Lead District – Richwoods Superfund Site
Operable Unit 1
Washington County, Missouri

SITE NAME, LOCATION, AND DESCRIPTION

This Record of Decision (ROD) for the Washington County Lead District - Richwoods Site (Site), Operable Unit 1 (OU-1), concerns upcoming remedial actions to address lead surface soil contamination at residential yards and public areas across the Site. It provides background information, summarizes recent information driving the Selected Remedy, identifies the Selected Remedy for cleanup and its rationale, and summarizes public review and comment on the Selected Remedy.

This ROD is a document that the U.S. Environmental Protection Agency (EPA), as lead agency for the Site, is required to issue to fulfill the statutory and regulatory requirements found, respectively, in Section 117(a), of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. § 9617, as amended, and in the National Contingency Plan (NCP), 40 CFR. § 300.430(f)(4). The support agency is the Missouri Department of Natural Resources (MDNR). EPA plans to conduct the remedial action as federal fund-lead work.

The Site covers a portion of northeastern Washington County, Missouri, and, as a mining site, includes any media impacted by heavy metals related to historical mining and milling activities. The Site is located in Washington County, approximately 70 miles south of St. Louis, in southeastern Missouri within the Old Lead Belt, where heavy metal mining has occurred since the early 1700s and industrial mining since has occurred since the 1800s. The Site consists of residential properties and child high impact areas located within the Site boundaries shown in Figure 1 that have been impacted by past mining practices and the migration of the resulting mine waste. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identity number is MON000705032. A citizen can use the CERCLIS number on EPA's web site to get information on the Site. A glossary of common Superfund terms is included at the end of this document.

This ROD highlights key information from the Remedial Investigation (RI), Baseline Human Health Risk Assessment (HHRA), Feasibility Study (FS), and Proposed Plan recently released for the Site. These and other documents are available for additional information regarding the upcoming remedial action in the Site Administrative Record (AR) located at the Washington County Library or EPA Region 7 Office in Kansas City, Kansas, at the addresses listed below:

Richwoods R-VII Elementary School
10788 State Highway At
Richwoods, Missouri 63071

or

U.S. Environmental Protection Agency, Region 7
Records Center
901 North 5th Street
Kansas City, Kansas 66101
Hours: Monday – Friday, 8:00 a.m. - 5:00 p.m.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Activities leading to current problems: Soil and/or groundwater contaminated by arsenic, barium, cadmium, and lead at the Site is most likely the result of long-term mining at the Site. Continuous lead mining began in Washington County in 1721 at the surface and near-surface (typically ten feet or less below ground surface [bgs]) in an area north of Potosi. Galena, the main lead ore, was mined in both the red clay residuum, which generally ranged from a few feet to over 30 feet thick, and the underlying dolomite bedrock. Originally, the predominant method of mining was hand mining and cleaning of ore from small pits and shafts in the residuum resulting in spacing between pits and shafts for mine stability. The Missouri Geological Survey reported that the density of surface lead mining in Washington County was extensive. In 1799, deeper mining began in the county and by the late 1800s, a large number of mines penetrated the dolomite bedrock to 100 feet bgs or deeper.

Barite (barium sulfate), another local mineral, became valuable after the Civil War and barite mining began to boom in the area in 1926. Most of the barite was mined from the residuum. Many of the later, large, mechanized barite mining operations reworked lands that had previously been hand mined since there was often barite ore in the undisturbed space between the pits and shafts generated from earlier surface lead mining. Remnants of mining activities throughout the area include strip mines, mineshafts, mine dumps, tailing areas, small smelters, tailings ponds, and associated dams. Generally, large tailings piles from either lead or barite mining or both were not created within the Site area since the waste rock was placed back in the existing pits. However, there are some tailings piles, numerous tailings impoundments, associated dams, and leachate ponds associated with the more recent barite mining. Limited investigation of these tailings has shown primarily lead levels present above residential, health-based screening levels. No human-made clay liners are known to be present beneath these tailings. These deposits may have contaminated soil, sediments, surface water, and groundwater. These materials also may have been transported by wind and water erosion or manually relocated to other areas throughout the Site.

Federal, state, and local site investigations, and removal or remedial actions: During 2005, EPA and MDNR conducted a Pre-CERCLIS Screening Assessment and a Preliminary Assessment/Site Inspection (PA/SI). The Pre-CERCLIS Screening Assessment focused on a general qualitative, assessment of the Site, while the PA/SI evaluated sampling data to assess the impact of contamination on nearby human health and the environment. Thirty-two of 141 residential properties were found to have lead in soil at concentrations exceeding the EPA residential, lead in soil, screening level of 400 ppm. In 2006, the EPA initiated a Removal Site Evaluation (RSE) that continued to evaluate residential properties for metals contamination in yard soil. The RSE was completed in May 2007, after time-critical-removal actions (TCRA) were initiated to address highly contaminated residential soil and contaminated wells private residential properties. Subsequent characterization of residential properties performed during the completion of TCRAs has identified a total of 66 out of 370 properties with soil lead levels exceeding 400 ppm. However, 19 of the 66 properties have since been remediated under TCRAs leaving 47 properties with soil lead levels exceeding 400 ppm (see Documentation of Significant Changes).

Some arsenic concentrations in soil exceeded health-based levels of concern, although elevated arsenic concentrations in areas where lead is not elevated may be due to background/naturally occurring conditions.

As part of the Site investigations described above, groundwater sampling of private drinking water wells was conducted. Current RSE data for the Site shows that groundwater samples were collected from 332 privately owned drinking water wells for analysis of lead, cadmium, barium, and arsenic. Lead was detected in 55 wells at concentrations above the federal drinking water standard maximum containment level(MCL) of 15 μg/L, and barium was detected in one well at a concentration exceeding the MCL of 2,000 μg/L.

In December 2005, the EPA formally approved commencing a TCRA at the Site. The objective of the removal action was to eliminate or reduce potential ingestion exposure of lead and other heavy metals to residents from drinking water and/or soil. Alternative drinking water was offered to residences where the drinking water exceeded the federal drinking water standards for lead, arsenic, barium, and cadmium. The EPA is currently providing an alternative drinking water supply for drinking and cooking to 45 residences. Additionally, from October 2006 to September 2009, the EPA excavated, removed, and replaced lead-contaminated soils and/or wastes from 19 properties where soil lead concentrations exceeded 1,200 ppm, and those properties where soil lead concentrations exceeded 400 ppm where there was known to be a child 84 months of age or younger with an Elevated Blood Lead (EBL) level greater than 10 micrograms per deciliter (μg/dl).

As a result of the elevated levels of heavy metals present in groundwater, the Site was placed on the National Priorities List on March 19, 2008. The Remedial Investigation (RI) Report and Feasibility Study (FS) Report for the Site were issued in February and July 2010, respectively. Both the RI and FS are in the AR.

COMMUNITY PARTICIPATION

The public was encouraged to participate in the Proposed Plan and ROD process for the lead-contaminated residential surface soil at the Site. The Proposed Plan highlighted key information from the RI Report, FS Report, HHRA, and other supporting documents in the AR. Additionally, the public historically has been made aware of the environmental issues at the Site through fact sheets, public availability sessions, and press releases during the previous removal cleanups that have occurred at the Site. To provide the community with an opportunity to submit written or oral comments on the Proposed Plan for the residential soil, EPA established a 30-day public comment period that commenced on July 20, 2010, by placing a display ad in the <u>Independent Journal</u> and mailing fact sheets to the local community. A second public notice was placed in the <u>Independent Journal</u> on August 26, 2010, notifying the public that additional documents had been added to the AR and that the comment period had been extended through September 24, 2010. At the request of a member of the public, the public comment period was extended to December 1, 2010, and a third public notice was placed in the <u>Independent Journal</u> on October 14, 2010. A public meeting was held on July 21, 2010, at 7:00 p.m. at the

Richwoods R-VII Elementary School in Richwoods, Missouri, to present the Proposed Plan, accept written and oral comments, and answer any questions concerning the proposed cleanup. Eleven citizens attended the public meeting. A summary of the verbal questions received at the public meeting and the responses is provided in the attached Responsiveness Summary. The Responsiveness Summary also contains a summary of written correspondence received during the public comment period and EPA's written responses to public comments.

SCOPE AND ROLE OF THE RESPONSE ACTION

The ROD for OU-1 addresses surface soil in residential properties at the Site. The Site has been divided into four OUs to organize the work into logical elements based on similar contaminated media. The EPA will continue to assess the OUs that are not included in this ROD and any future remedial actions will be addressed in subsequent Proposed Plans and RODs. The four OUs are described in detail as follows:

- OU-1 consists of the contaminated surface soils identified at residential and child high use properties.

- OU-2 consists of the contaminated groundwater and in particular the private drinking water wells.

- OU-3 consists of mine waste areas and soils contaminated by historical mining activity that have not been included in OU-1.

- OU-4 consists of the surface waters and surface water sediment potentially impacted by historical mining activity.

The Selected Remedy represents EPA's approach to address OU-1. This includes lead-contaminated surface soil present at residential properties at the Site that have been contaminated as a result of migration of metal-bearing materials from past mining practices. For the purposes of this ROD, the term residential properties includes properties that contain single- and multi-family dwellings, apartment complexes, vacant lots in residential areas, schools, daycare centers, playgrounds, and public parks. Under the Selected Remedy, the residential properties will be addressed first to expedite cleanup of the areas that pose the greatest and most immediate threats to human health. The Selected Remedy represents the first remedial action for the Site and is a continuation of the residential soil cleanup actions that have been conducted over the past several years as time-critical removal actions. The remaining remedial response actions for the other OUs may be addressed by future RODs.

The total number of residential properties with lead-contaminated soil across the Washington County Lead District–Richwoods Site that will be addressed under this remedial action is estimated at 79 properties. This number comes from properties with measured soil lead concentrations at or exceeding 400 ppm combined with an estimated percentage of properties not yet characterized, but expected to have soil lead concentrations exceeding 400 ppm. The 400 ppm action level for lead in residential soil is based on the site-specific Human Health Risk

Assessment (HHRA) and assumes lead is measured in the bulk soil sample with an X-Ray Fluorescence (XRF) instrument. To a lesser extent, arsenic was identified as a contaminant of concern in residential soil and will have an action level of 22 ppm. Figure 1 shows the general location of contaminated residential properties at the Site.

This ROD for OU-1 addresses surface soil in residential properties at the Site. Under any remedial strategy, a number of years will be required to investigate and evaluate remedial alternatives for the residential properties at the Site. The current goal is to complete the cleanup work at OU-1 by 2014, and complete all cleanup work at the Washing County Lead District by 2043.

SITE CHARACTERISTICS

Geographical and topographical information: The Site covers approximately 45 square miles of eastern Washington County, Missouri. Site boundaries are delineated on Figure 1. Topographically, the Site is comprised of gently rolling hills with slightly graded streams, usually less than 200 feet below the higher hilltops.

Bedrock at the Site is predominantly the Upper Cambrian-aged Eminence and Potosi Dolomites. The Potosi Dolomite contains an abundance of druse-coated chert, while the overlying Eminence Dolomite contains little druse-coated chert. The Potosi ranges from about 75 to 300 feet in thickness in its outcrop area, with an average thickness of 200 feet. The Eminence has an approximate thickness of 200 to 250 feet. The Ordovician Canadian Series Gasconade Dolomite and Roubidoux Formation are present to the north and west in portions of the Site area, overlying the Eminence Dolomite. Most lead and barite mineralization at the Site occurs in fractured and solutioned bedrock and in red clay residuum derived chiefly from the Potosi and Eminence dolomites. The soil at the Site is roughly 10 to 80 percent clay and can range from silty clay on hill tops to gravelly clay in most low areas.

Type and sources of contamination: Past mining operations have left spoils in the form of tailings deposits from smelting and mineral processing operations in the Washington County Lead District. The mine waste contains elevated levels of lead and other heavy metals which pose a threat to human health and the environment. These deposits have contaminated soils, sediments, surface water, and groundwater. These materials may also have been transported by wind and water erosion or manually relocated to other areas throughout the county.

A conceptual site model (CSM) for human exposure pathways to heavy metals resulting from mine waste at the Site is included as Figure 2. It should be noted that although the CSM covers all anticipated human exposure at the Site, this ROD is focused on addressing the highest human health threat at the Site, namely, the exposure of child residents to lead in residential property surface soil and the resulting contaminated indoor dust via incidental ingestion.

Sampling Strategy: Surface soil sampling of residential properties was performed similarly to the approach taken during previous removal actions. Soil has been sampled and analyzed for metals at approximately 370 residential properties. The sampling generally involved dividing a residential property into four quadrants and compositing five aliquots of surface soil from each quadrant. Typically, separate multi-aliquot samples were collected from gardens, child play areas, and nonpaved driveways. Samples were analyzed using an XRF. A small percentage of soil samples were sent off-site for laboratory confirmation analysis.

Additionally, potable water samples were collected from properties with individual wells, and a limited set of indoor dust samples were collected for use in the HHRA. Indoor dust samples were collected by a high-volume vacuum cleaner from unremediated homes that had surface soil concentrations in their respective yards ranging from 47 ppm to 7,596 ppm.

In the HHRA, lead was identified as the primary contaminant of concern (COC). Other metals were identified in various media and locations as COCs in select situations. However, the ROD focuses on lead since it is the predominant COC in residential property soils at the Site. Lead is a metal and a constituent of D008 hazardous waste. It is classified by the EPA as a probable human carcinogen and is a cumulative toxicant. The organic form of lead is generally unstable and undergoes rapid conversion to inorganic lead compounds. Most forms of inorganic lead are relatively insoluble, tend to bind tightly to soil, and are not very mobile.

Quantity of waste and concentrations of lead in soil: The total number of residential properties with lead-contaminated surface soil that will be addressed under this remedial action is estimated at 79 properties. This number comes from properties with measured lead soil concentrations greater than 400 ppm (47 properties), and an estimated number of properties not yet sampled, but that potentially could exceed 400 ppm lead in surface soil (32 properties). The 400 ppm action level for lead in residential surface soil is based on the site-specific HHRA described in the next section and assumes lead is measured in the bulk soil sample with an XRF. As shown on Figure1, the properties currently identified for cleanup are scattered across the Site.

The number of residential properties not yet sampled but that potentially could require remediation is estimated to be 32 properties and is calculated as follows. It is estimated that approximately 176 residential properties at the Site have not yet been sampled. Historically, 18 percent of the properties actually sampled at the Site contained lead concentrations greater than 400 ppm. Assuming the same percentage of the properties that have not yet been sampled contain lead concentrations greater than 400 ppm, the number of properties with lead levels greater than 400 ppm is estimated at 32 properties. Therefore, when adding the number of properties that are known to need remediation (47 properties) and the number of properties which are estimated to need remediation (32 properties), the total number of residential properties expected to be addressed under this remedial action is estimated to be 79 properties.

Based on EPA's previous soil removal activities at the Site, an average residential property has approximately 500 yd^3 of lead-contaminated soil. Therefore, it is estimated that approximately 39,500 yd^3 of residential soil is contaminated with lead above 400 ppm at the Site.

Lateral and vertical extent of contamination and likelihood of migration: There is considerable variability in lead concentrations found in surface soil at residential properties at the Site, both from property to property and within each individual property. The actual amount of past mining and smelting on any given property, as well as soil movement, would greatly affect lead soil concentrations at a residential property. Later modification of residential properties resulting from filling, grading, or other activities could potentially cover or dilute lead contamination at the surface. Erosion of surface soil during rain events can relocate lead-contaminated soil. It is likely that a combination of these factors has resulted in the observed discontinuous horizontal nature of lead contamination in soil at residential properties across the county. The vertical extent of lead contamination in residential soil also varies. People at the properties impacted by surface soil with lead concentrations above 400 ppm are potentially exposed through the route of ingestion.

CURRENT AND POTENTIAL LAND USE

The primary land use within the Site is agricultural crop and pasture land since mining operations have ended. Industrial activities consist of light manufacturing and construction. The population is predominantly rural. Based on 2000 census data, the population at the Site is estimated to be 1,431 including 542 housing units. Residential properties addressed by this remedy are expected to be used for the same purpose in the future.

SUMMARY OF SITE HUMAN HEALTH RISKS

A baseline HHRA dated February, 2010, (included in the AR as an RI appendix) was conducted to assess the potential risks to humans, both now and in the future, from site-related contaminants present in environmental media including surface soil, indoor dust, sediment, surface water, groundwater, and fish tissue. The HHRA assumes that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The results of the risk assessment are intended to help inform risk managers and the public about potential human health risks attributable to site-related contaminants and to help determine if there is a need for action at the Site. For most heavy metals, the chemicals of potential concern (COPCs) at the Site, the HHRA follows the standard risk assessment process: (1) identification of COPCs, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization. However, as explained in more detail later, the toxicity and exposure assessments, as well as the risk characterization for lead, are intrinsically included in the Integrated Exposure Uptake Biokinetic (IEUBK) model used to evaluate potential lead effects on human health. This section of the ROD summarizes the results of the HHRA.

COPCs are chemicals which exist in the environment at concentrations that might be of potential health concern to humans and which are or at least might be derived in part from site-related sources. At mining sites, the COPCs are generally metals and other inorganic chemicals that occur in mine waste. Table 1 lists the COPCs as identified by the HHRA given the large number of COPCs at the Site and the high number of media they can impact. Detailed information on the number of samples, their locations, the media from which they were collected, the number of detections, and range of concentrations is included in the RI.

In contrast, COCs are those chemicals which exist in the environment and have been shown by a risk assessment to be of concern to human health. The HHRA integrated the results of the toxicity and exposure assessments to derive the quantitative hazards that may occur due to exposure to COPCs. Ultimately in the HHRA, lead was the most frequently identified COC in soil, and is the primary risk driver for the remedial action described in this ROD. Arsenic and cobalt were also identified as COCs in residential soil. Details of the HHRA risk analysis can be found in Appendix G and H of the HHRA. This ROD focuses on lead because it is the primary COC at the Site. Lead ranged from approximately 10 to over 45,000 ppm in surface soil at approximately 1,685 residential properties.

Exposure pathways and exposed populations: Figure 2 presents the CSM which shows the variety of exposure pathways by which Site-related COPCs may migrate from on-site mine waste piles or contaminated surface soils acting as sources of contamination for other environmental media such as soil and indoor dust. The CSM also shows the various human populations that might reasonably be exposed to heavy metals and in particular to lead in the environment. However, not all of these potential exposure pathways are likely to be of equal concern. Additionally, with respect to residents, a potential exposure scenario was not quantitatively addressed in the HHRA, and is identified as exposure to heavy metals by ingestion of garden vegetables.

With respect to lead contamination, young children (typically defined as 84 months of age or below) residing within the Site boundaries are the population group of primary concern potentially exposed to lead at the Site. Young children are more susceptible to lead exposure than adults because they have higher contact rates with soil or dust, absorb lead more readily than adults, and are more sensitive to the adverse effects of lead than are older children and adults. Thus, the most important exposure pathway for children is incidental ingestion of soil and dust. The adverse health effects of greatest concern in children are impairment of the nervous system, including learning deficits, lowered intelligence, and adverse effects on behavior.

The risks or potential for adverse health effects from lead are evaluated using a different approach than for most other metals. Because lead is widespread in the environment, exposure can occur by many different pathways. Thus, lead risks are based on consideration of total exposure (all pathways) rather than just site-related exposure. Because most studies of lead exposures and the resultant health effects in humans have traditionally been described in terms of blood lead level (expressed in µg/dL), lead exposures and risks are typically assessed using mathematical models. Additionally, because lead does not have nationally-approved toxicological values which can be used to assess risk, standard risk assessment methods cannot be used to evaluate the health risks associated with lead contamination. Therefore, the HHRA used EPA's IEUBK Model for Lead in Children to estimate the distribution of blood lead levels in a population of residential children exposed to lead at the Site. Typically, the focus of an HHRA with respect to lead in a residential setting is on children since they are at a greater risk than older children or adults. By using a lead model for the population at greatest risk adults, including pregnant women, are also protected. Thus, the IEUBK model was used to evaluate the risks posed to young children (6 to 84 months) as a result of the lead contamination at the Site.

In the case of lead, risks are evaluated using a somewhat different approach, namely the IEUBK model, which can be used to evaluate all exposure pathways. The IEUBK model uses site-specific and default inputs (i.e., surface soil concentration, indoor dust concentration, bioavailability, etc.) to evaluate exposure from lead in surface soil, drinking water, dust, and ambient air to estimate the probability that a child's blood lead level might exceed 10 µg/dL.

EPA's health protection goal is that there should be no more than a 5 percent chance of exceeding a blood lead level of 10 µg/dL in a given child or group of similarly-exposed children. The basis for this goal is that the Centers for Disease Control and Prevention and the EPA have conducted analyses demonstrating health effects at or below a blood lead level of 10 µg/dL.

For a residential child, the IEUBK model was run for each individual residential property because most exposure for a young child will occur at their residence using available site-specific data. First, surface soil lead concentrations, represented by concentrations in soil particles less than 250 micrometers (µm), at 48 individual unremediated residential properties were included in the HHRA. Second, testing was performed to estimate the relative bioavailability (RBA) or the amount of lead absorbed into the body from the gastrointestinal tract following ingestion of lead-contaminated soil. The results indicated that the average uptake of lead at the Site is slightly lower than the IEUBK model default value. Default inputs were used for the remaining IEUBK model input parameters.

<u>Risk results for residents from surface soil</u>: Of the 48 residential properties evaluated during the HHRA, children residing at 32 properties (66.7 percent) are predicted to have greater than a 5 percent chance of exceeding a blood lead level of 10 µg/dL. Children in the remaining 16 homes (33.3 percent) are predicted to have blood lead levels at or below EPA's health protection goal. Table 2 summarizes the risks to residents from exposure to lead in surface soil. The risk assessment results indicate that a child exposed to residential property lead surface soil concentrations above 493 ppm (see Documentation of Significant Changes section below) would have greater than a 5 percent chance of exceeding a blood lead level of 10 µg/dL. These results, when considered in conjunction with the estimated number of properties yet to be sampled, indicate that approximately 79 unremediated homes at the Site are of potential health concern with regard to lead.

The HHRA performed a qualitative analysis of arsenic in soils, sediment, and mine waste and concluded that arsenic is a contaminant of concern for current and future exposures. Residential surface soil containing arsenic above 22 ppm will be remediated by removing up to 12 inches of soil and replacing with clean soil. This cleanup level was derived in a manner consistent with the 2010 HHRA and current EPA risk assessment guidance and policy (USEPA, 2010). Given that background levels of arsenic in Washington County are greater than cleanup goals corresponding to cancer risks of 10^{-6} and 10^{-5}, the cleanup level is based on the noncancer hazard index of 1, which is lower than a cleanup goal based on a cancer risk of 10^{-4}(USEPA, 2010). Based on qualified Site data, it is anticipated that residential soil remediation will be necessary for minimal properties due to elevated arsenic levels.

The HHRA also determined that soil at one residential property may present a noncancer risk to children due to elevated cobalt, excluding lead, at the maximum sample concentration. It is important to note that if these risks were based on average concentration of cobalt in soil, the residential property soils would not exceed a level of concern for children. Since cobalt concentrations detected at the Site are only slightly elevated and infrequent, where cobalt in soil presents a risk to children and is co-located with lead at a concentration greater than 400 ppm, EPA will address this risk under this proposed remedial action. Where cobalt concentrations are elevated, but lead concentrations are not above 400 ppm, EPA will not be addressed under this proposed remedial action.

Risk estimates for residents from groundwater: Groundwater is outside the scope of this operable unit, and this information is provided as background for the site. Sampling of private drinking water wells commonly found at the Site detected lead concentrations exceeding the Safe Drinking Water Act Action Level of 15 µg/l at approximately 55 out of 332 wells sampled. In addition, barium was detected in one private well exceeding the MCL of 2,000 µg/L. Under a time-critical removal action, EPA has provided a temporary, alternative drinking water source to the majority of the residences using these wells. As described above, the contaminated drinking water wells have been defined as OU-2, and EPA intends to provide a more permanent remedy for these contaminated drinking water sources through future remedial action.

Uncertainties: Quantitative evaluation of the risks to human health from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentrations in the environment, the true amount of human contact with contaminated media, and the true dose-response curves for noncancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of an HHRA. In most cases, assumptions employed in the HHRA to deal with uncertainties were intentionally conservative. Thus, they are more likely to lead to an overestimate of risk rather than an underestimate of risk.

Summation

With respect to lead as the primary COC final cleanup levels in residential property surface soil at Superfund sites are based on the IEUBK model results and the nine criteria analysis included in this ROD in accordance with the NCP at 40 CFR. § 300.430(e)(9)(iii) and incorporated by reference at 40 CFR. § 300.430(f). EPA generally selects a residential surface soil cleanup level within the range of 400 ppm to 1,200 ppm for lead, although lower or higher cleanup levels are possible based on input of site-specific data into the model. As described above, the IEUBK modeling results for the Site recommend a maximum lead surface soil concentration of 493 ppm (see Documentation of Significant ChangesSection below) to ensure that a child has less than a 5 percent probability of having a blood lead level exceeding 10 µg/dL. Although it was appropriate to use a site-specific RBA in the characterization of risk in the HHRA, EPA considered that application of a site-specific RBA in the development of a cleanup level for the range of residential properties at the Site would not be protective of residences with soils that are associated with higher bioavailability. Due to the variance in the RBA of lead observed in residential soil samples collected at the Site, EPA is selecting the screening level of 400 ppm lead as the residential surface soil cleanup level.

The response action selected in this ROD is necessary to protect public health from actual releases of pollutants or contaminants from this Site which may present an imminent and substantial endangerment to public health or welfare. This ROD only addresses the human health risk posed by soils at residential properties within the Site boundaries. Although an Ecological Risk Assessment was completed for the Site, a summary of it has not been included in this ROD because its emphasis was focused on streams, lakes, and unpopulated areas, and not on residential soils. Consideration was not given to residential soils when developing the Ecological Risk Assessment because they were not considered to be ecologically sensitive habitat. In addition, the ecological cleanup goal developed for lead in nonresidential soils exceeds the human health cleanup goal, and would therefore be addressed through the implementation of the selected remedy described in this ROD. The ecological screening levels for arsenic and cobalt, which are typically more conservative than site-specific, risk-based action levels, are also higher than the human health action levels developed for the Site.

Other identified risks to human health and the environment such as mine waste piles and contaminated groundwater will be addressed in future cleanup decisions at the Site.

REMEDIAL ACTION OBJECTIVES (RAO)

RAOs consist of quantitative goals for reducing human health and environmental risks and/or meeting established regulatory requirements at Superfund sites. RAOs are identified by reviewing site characterization data, risk assessments, applicable or relevant and appropriate requirements (ARARs), and other relevant site information.

Based on current Site data and evaluations of potential risk, lead was identified as being the primary COC, and to a lesser extent arsenic. The primary cause of human health risk from residential property soil at the Site is through direct ingestion (by mouth). RAOs have been established for residential property surface soil at the Site that are consistent with EPA guidance including the Superfund Lead-Contaminated Residential Sites Handbook. Thus, the RAOs for the residential property soil at the Site are to:

- **Reduce the risk of exposure of young children (children under seven years old) to lead such that an individual child or group of similarly exposed children have no greater than a 5 percent chance of exceeding a blood lead level of 10 µg/dL.**

- **Remove residential surface soils contaminated with lead exceeding 400 ppm and arsenic exceeding 22 ppm.**

By meeting these RAOs, unlimited use of and unrestricted exposure to Site surface soil by young children will not result in an unacceptable health risk. Based on site-specific information, EPA's IEUBK model predicts that a young child residing at the Site will have greater than a 5 percent chance of having a blood lead level exceeding 10 µg/dL if the lead soil concentrations to which he or she is exposed are above 493 ppm (see Documentation of Significant Changes section below) under the assumed exposure conditions. As described above, a slightly more protective concentration of 400 ppm lead in surface soil will be the cleanup level of the remedial action as measured in the bulk soil fraction using an XRF.

DESCRIPTION OF ALTERNATIVES

Description of Remedy Components

Three alternatives were developed in the FS to meet the identified RAOs. The alternatives were developed to specifically address lead-contaminated residential surface soil. With the exception of depth of soil remediation, Alternatives 2 and 3 have common elements.

The EPA considered phosphate treatment for reducing the risk of exposure to contaminated soils during the preliminary screening of remedial alternatives for the Feasibility Study. At that time, an extended study of phosphate treatment technology at the Oronogo-Duenweg Superfund Site in Jasper County, Missouri, had achieved a maximum of 40 percent reduction in bioavailability over a seven year study period. However, the technology had not undergone any implementability testing at a residential property by EPA. A recent review of the technology at the Omaha Lead Site entitled "Evaluation of Phosphate Treatment at Residential Properties; Omaha Lead Site, Omaha, Nebraska" has indicated concern about implementability, cost effectiveness and community acceptance in a residential setting, as well as the long-term presence and monitoring of lead in the soil even if its bioavailability has been reduced. Based on these studies and the similarity in sites, the EPA concluded that phosphate treatment of residential soils contaminated with lead would no longer be considered for evaluation as a remedial alternative for OU1.

Alternative 1: No Action

The NCP at 40 C.F.R. § 300.430(e)(6) requires that EPA consider a no-action alternative against which other remedial alternatives can be compared. Under this alternative, no further action would be taken to monitor, control, or remediate the threat of lead in residential property soil at the Site. Alternative 1 would not meet the RAOs because it does not minimize or eliminate the existing or future potential exposure at the Site.

Alternative 2: Maximum 12-Inch Excavation, Disposal, Vegetative Cover, Health Education and Institutional Controls

- Excavation and removal of surface soil above 400 ppm lead to soil with lead below 400 ppm or to a depth of 12 inches. A visual marker barrier will be placed at the base of 12-inch excavations where lead levels are at or exceed 1,200 ppm.
- Clean fill and topsoil replacement along with revegetation
- Disposal of excavated soil at a repository
- Vacuum cleaner distribution
- Health education
- Institutional Controls (ICs)

Under this alternative, residential properties with at least one quadrant surface soil sample testing greater than 400 ppm for lead will have that quadrant removed and replaced. If the drip zone surface soil sample from any property where a soil quadrant is being replaced also exceeds a concentration of 400 ppm lead, the property will also have the drip zone soil removed and replaced. Residential properties where only the drip zone soil and no other quadrant soil exceeds 400 ppm lead would not be addressed in this action. Based on existing surface soil sampling data and trends in that data, 79 residential properties contain or are expected to contain lead surface soil concentrations greater than 400 ppm and will require remediation. This alternative includes the excavation and removal of lead-contaminated surface soil, backfilling the excavation with clean soil, and revegetation.

In general, excavation will continue in depth until the underlying soil at the bottom of the excavation is less than 400 ppm lead or to a maximum depth of 12 inches bgs, whichever is less.

If at 12 inches below ground surface (bgs) the lead soil concentration is equal to or greater than 1,200 ppm, EPA will place a marker barrier prior to backfilling with clean soil. An exception is existing garden areas, where the maximum depth of excavation will be 24 inches bgs. The barrier placed will be a visible plastic barrier (such as orange mesh plastic webbing) that is permeable, wide meshed, and will not affect soil hydrology or vegetation. The physical barrier will function as a visual warning that digging lower will result in exposure to soils contaminated at a level that EPA has determined to be a human health concern. Clean fill and topsoil will be used to replace excavated soil, returning the residential property to its original elevation and grade. The property typically would then be hydroseeded to restore the original vegetation unless conditions warrant sodding. The estimated time for the cleanup of the 79 properties is approximately three years. However, this time can be reduced to as little as one year if aggressive work schedules are implemented. Future land use is expected to continue to be residential.

The excavated soil will be disposed of at the Indian Creek tailings pile or an alternate location depending on the arrangements that can be secured at the Indian Creek tailings pile. EPA has previously used the Indian Creek Repository for disposal of excavated lead-contaminated soil. The capacity of the Indian Creek Repository has been approved for the disposal of lead-contaminated residential soil under a Remedial Action Plan (RAP.) For contaminated soil which would fail the Toxicity Characteristic Leaching Procedure (TCLP) analysis, a lead stabilization compound will be added to the soil at the residential property until the soil no longer fails the TCLP standard for lead. The repository would require storm water controls and other design and engineering controls for long-term stability. As part of this alternative, long-term operation and maintenance, including erosion controls, storm water controls, and groundwater monitoring, would be performed.

EPA will not intentionally address naturally occurring lead ores in their undisturbed state as part of this action. Although the Site has been heavily mined in the past, it may be possible to encounter naturally occurring lead ores during residential property excavation. Section 104(a)(3)(A) of CERCLA states that removal or remedial actions shall not be provided in response to a release or threat of release "of a naturally occurring substance in its unaltered form, or altered solely through natural processes or phenomena, from a location where it is naturally found." Naturally occurring lead ores could be found at the bedrock interface and in undisturbed clay soils near the ground surface. Another indicator of the presence of naturally occurring lead ores could be a high density of galena crystals in soils or unusually high concentrations of lead in excavated soils. When these conditions are encountered, they will be documented, excavation will stop, and backfilling will be initiated.

High-efficiency particulate arrestor (HEPA) vacuum cleaners will be distributed to residences that have their yard soils remediated under this alternative in order to address the lead dust that is typically tracked into homes at properties where elevated soil lead has been identified. ATSDR recommends that home interiors regularly be cleaned of house dust and soil in areas where there is lead contamination for the purpose of reducing exposure to lead. This conclusion is also supported by the IEUBK Model, which includes a dust transfer factor that is based on the movement of outside soil lead into the interior of a home.

Due to the widespread lead contamination found at the Site, a health education program will be implemented to help reduce exposures that could potentially result in adverse health effects. An active educational program would be conducted in cooperation with EPA, ATSDR, MDNR, MDHSS, and the Washington County Health Department. It is anticipated that EPA funding will be provided for the implementation of health education activities. During the implementation of the remedial actions, EPA will provide an annual mailing to Washington County residents warning of potential exposures to lead and actions to take that can reduce lead exposure. The following, although not an exhaustive list, indicates other types of education activities that may be conducted at the Site:

- Performing in-home assessments for children identified with elevated blood lead levels
- Holding meetings with and acting as a resource for area physicians of local families
- Providing community education through meetings, talks, and presentations at civic clubs, schools, nurseries, preschools, churches, fairs, etc.; and one-on-one family assistance
- Undertaking special projects to increase awareness of how local citizens can protect themselves from lead exposure health risks
- Door-to-door distribution of HEPA vacuum cleaners to residences and providing household cleaning and exposure reduction instruction.

With regard to the physical barriers that have been and may be put down at depth at residential properties during the previous removal actions and this remedial action, EPA will need to ensure that the marker barriers and the contaminated soils below them are not disturbed for long-term protection of human health. EPA has historically looked to various types of ICs to ensure the remedy's long-term protectiveness. For this alternative, EPA will work with state and local officials and land owners to explore potential ICs for properties where soil lead contamination remains at depth, i.e., where marker barrier was placed; and on those properties where EPA has data indicating surface soil lead contamination exceeds 400 ppm and EPA was unable to get access from the property owner to perform soil remediation. All property owners where unacceptable levels of lead remain in place will be notified and provided information on lead disclosure requirements in accordance with the Toxic Substances Control Act (TSCA Disclosure Rule 1018) that property owners would be required to follow.

Implementation of future governmental controls, such as an ordinance requiring soil assessment sampling and permits for earthmoving activities as well as restricting soil use in areas of known heavy metal contamination, would be efficient and effective control measures. Discussion, collaboration, and evaluation with the state of Missouri, Washington County, and other local governments regarding these types of governmental controls will be initiated by EPA.

Because EPA will continue to evaluate other types of ICs for residential properties and mine wastes at the Site, the final measures for governmental controls will be determined and described in more detail in a future FS, Proposed Plan, and ROD for the Site. Other ICs being considered will include deed notices, local governmental controls such as building permit restrictions, restrictive covenants, and builder and developer certifications that require specific training on best management practices when developing potential properties impacted by historical mining practices.

Alternative 3: Maximum 24-Inch Excavation, Disposal, Vegetative Cover, Health Education, and Institutional Controls

- Excavation and removal of surface soil above 400 ppm lead to soil with lead below 400 ppm or to a depth of 24 inches. A visual marker barrier will be placed at the base of 24-inch excavations where lead levels are at or exceed 1,200 ppm.
- Soil disposal, clean fill and topsoil replacement, and revegetation, same as Alternative 2
- Vacuum cleaner distribution, same as Alternative 2
- Health education, same as Alternative 2
- ICs, same as Alternative 2

Just as in Alternative 2, under Alternative 3 residential properties with a quadrant showing a surface soil sample result greater than 400 ppm for lead will be remediated. Also, the drip zone may be remediated, if the lead concentrations in the drip zone are greater than 400 ppm. Residential properties where quadrant samples did not exceed 400 ppm lead would not be addressed under this action. Under this alternative, 79 residential properties contain or are expected to contain lead soil concentrations greater than 400 ppm and will require remediation.

Approximately 176 residences at the Site have not had their residential property soil sampled by EPA. Under this alternative, EPA will continue to seek access to and sample all residential properties at the Site to determine if they have been impacted by mining-related activities. If a soil sample for a property quadrant has a lead concentration greater than 400 ppm, the property will be included in the remedial action.

The significant difference with this alternative when compared to Alternative 2 is that soil excavation would continue to a maximum depth of 24 inches where soil lead contamination is determined to be 400 ppm or greater. If at 24 inches bgs the soil lead concentration is equal to or greater than 1,200 ppm, EPA would place a marker barrier prior to backfilling with clean soil and would implement ICs, as in Alternative 2, after consulting with ATSDR on the need for ICs for soil lead contamination remaining at the 24-inch depth. However, EPA anticipates that the need for barrier and institutional controls would be reduced (when compared to a 12-inch maximum depth excavation) because homeowners would dig in their yards to depths exceeding 24 inches on rare occasions, and believes that those instances would not result in soil lead levels remaining at the surface that would pose a significant exposure risk to lead. The frequency of post remediation excavation by residents to depths greater than 24 inches is expected to be minimal over time, and the perpetual implementation of institutional controls would be necessary on fewer properties in order for human health and the environment to be protected.

The repository, vegetation restoration, and health education components of Alternative 3 are the same as Alternative 2. Future land use for the Site under Alternative 3 is expected to be similar to Alternative 2.

Common Elements and Distinguishing Features of Each Alternative

Alternative 1 is removed from consideration because it is not protective of human health and the environment and does not meet ARARs. The two remaining alternatives, Alternatives 2 and 3, include the common elements of the selected repository (Indian Creek tailings pile), vegetation restoration, health education, and ICs. Both alternatives are similar in their attainment of key ARARs. The cost of Alternative 3 is 29 percent greater than Alternative 2, with Alternative 2 projected to cost approximately $2.23 million while Alternative 3 is projected to cost approximately $3.13 million. The key distinguishing feature of these two alternatives is the depth of soil excavation, 12 inches compared to 24 inches. Otherwise, the Alternatives are nearly identical.

It may take additional time to complete Alternative 3 when compared to Alternative 2, due to the anticipated increase in soil excavated. It was estimated that there would be a 50 percent increase in soil excavated when implementing Alternative 3. Based on required funding and a remedial action contractor's approach, additional time may be needed to complete the remediation of the estimated 79 residential properties at the Site.

It is also likely that ICs such as marker barriers would be necessary at fewer properties under the implementation of Alternative 3 when compared to Alternative 2. However, it is not known how many properties this would be. Furthermore, due to the uncertainty in whether individual residents would excavate soils in the future to depths greater than 24 inches, Alternative 3 may provide no greater degree of long-term effectiveness and permanence at residential properties where lead levels above levels of concern remain in place, and would not eliminate the need for similar ICs to those proposed in Alternative 2.

Expected Outcomes of the Alternatives

Excavation and replacement of contaminated surface soil as prescribed in Alternatives 2 and 3 would allow for unrestricted future use of many of the remediated properties. Under both alternatives, it is anticipated that a number of physical barriers will be required for placement at depth to indicate that lead-contaminated residential soil remains. Therefore, ICs will ultimately be needed for the Site. Residential use of all these properties could continue under either Alternative.

As indicated above, Alternatives 2 and 3 are similar and would require about the same amount of time to implement (3 years) dependent on funding and contracting requirements. Both Alternatives 2 and 3 are implementable.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

According to the NCP, nine criteria are used to evaluate the different alternatives individually and against each other in order to select the best remedy. The nine evaluation criteria are (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume of contaminants through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state/support agency acceptance; and (9) community acceptance. This section of the ROD profiles the relative performance of each alternative when measured against the nine criteria and each other. The nine evaluation criteria are discussed below. A detailed analysis of these alternatives can be found in the FS Report.

1. **<u>Overall Protection of Human Health and the Environment</u>:** Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or ICs.

Alternative 1 does not provide protection for the environment or residents at the Site because no actions are taken to mitigate the exposure to lead-contaminated surface soil. Alternatives 2 and 3 would remove the significant exposure pathway associated with contaminated residential property soils. Once soil excavation, disposal, replacement, and yard re-vegetation are complete; enforceable ICs and an effective health education program are implemented; the risk of exposure through direct contact and subsequent ingestion of metal-contaminated residential property soil will be mitigated. Therefore, Alternatives 2 and 3 are protective of human health and the environment. Under Alternative 3, enforceable ICs may be necessary at fewer properties due to the minimal risk associated with post remediation excavations by homeowners to depths greater than 24 inches.

2. **<u>Compliance with ARARs</u>:** Section 121(d) of CERCLA and the NCP at § 300.430(f)(1)(ii)(B) require that remedial actions at Superfund sites meet or satisfy legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA § 121(d)(4). Therefore, this criteria evaluates whether the alternative meets federal and state ARARs that pertain to the site or whether a waiver is justified. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a Superfund site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site, address problems or situations sufficiently similar to those encountered at the Superfund site that their use is well-suited to the particular site. State standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable or relevant and appropriate.

The ARARs for this ROD are included in Tables 3 through 8. The no-action Alternative does not comply with ARARs. In contrast, Alternatives 2 and 3 would comply with chemical- and location-specific ARARs. Action-specific federal and state ARARs would be achieved by making sure all soil above the cleanup level is excavated, transported, and disposed of properly. Storm water runoff will be kept to a minimum during soil excavation, disposal, borrow replacement, and hydroseeding using best management practices, thus keeping local streams free of additional sediment. Dust suppression will be used during all phases of construction, and time spent at each residence will be kept to a minimum to minimize potential exposure to the residents. All precautions will be considered at each location to ensure that excavation will not hinder or interfere with wildlife and local streams. Property owners with remaining lead contamination would be informed of their obligation to comply with lead data disclosure requirements in accordance with the TSCA Disclosure Rule 1018.

Having failed to meet both previous criteria, called the threshold criteria, Alternative 1, the No Action Alternative, is eliminated and will not be included in further NCP criteria analysis.

3. **Long-term Effectiveness and Permanence:** Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Under Alternatives 2 and 3, the residual risks (the risk remaining after implementation) would be significantly reduced. Residential properties within the Site with soil concentrations at or above 400 ppm lead in Alternatives 2 and 3 would have contaminated surface soil removed to a depth that meets the cleanup level, up to a depth of 12 inches or 24 inches respectively. The removal of contaminated soil, replacement with clean soil, and revegetation ensures that future potential for exposure will be significantly reduced. Alternatives 2 and 3 provide permanence through removal and containment of contaminated soils at or above 400 ppm at the prescribed maximum depths of 12 inches or 24 inches respectively.

A significant aspect of Alternatives 2 and 3 is the placement of the contaminated soils at the Indian Creek Repository. The repository would require storm water controls and other design and engineering controls for long-term effectiveness and stability. Maintenance of the repository would include routine inspections and repairs to erosion and vegetative cover. Storm water monitoring would be required in accordance with existing permits.

Significant components of both Alternatives 2 and 3, which impact long-term protectiveness of excavated properties, are the health education and ICs. Because contamination will remain on Site after the implementation of the selected remedy, the implementation of these initiatives over the long-term will be necessary to achieve the optimum reduction in risk of exposure to contamination remaining at depth in residential property soil.

Examples of ICs that would ensure long-term protectiveness of Alternatives 2 and 3 would include an ordinance restricting digging in areas where barriers were placed at depth over soil contaminated with lead above 1,200 ppm, restrictive covenants, or a requirement for building permits. EPA will work with local citizens and government officials at all levels to develop and implement effective ICs. Due to the uncertainty in whether individual residents would excavate soils in the future to depths greater than 24 inches, Alternative 3 may provide no greater degree of long-term effectiveness and permanence and may require similar ICs as those described in Alternative 2.

Reviews at least every five years would be necessary for Alternatives 2 and 3 to evaluate the effectiveness of these alternatives because lead soil concentrations above the health-based level of 400 ppm may remain at some residential properties.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment: Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 2 and 3 would significantly reduce the mobility of the COCs by consolidation of the contaminated soils at the Indian Creek Repository. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced by these alternatives with the exception of the treated and stabilized soils at the repository which would otherwise fail TCLP. The toxicity of the stabilized soils would decrease, although the volume of these soils is not expected to be a significant portion of the excavated residential soils.

Proper long-term maintenance of the Indian Creek Repository is an important component of Alternatives 2 and 3 to ensure the significant reduction of lead mobility. The effective implementation of ICs for Alternatives 2 and 3 will likely contribute to the reduction of lead mobility because the community would receive notification concerning the need to characterize and/or certify that soil brought to or removed from their properties did not contain lead at concentrations exceeding 400 ppm. The mechanical movement by man of lead-contaminated soil is suspected to be a major contributor to the mobility of lead soil contamination at the Site, and effective ICs such as deed notices and local ordinances regulating soil movement will be explored to reduce lead mobility by mechanical movement.

5. Short-term Effectiveness: Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternatives 2 and 3 have increased short-term risks for the public, environment, and construction workers from excavation and transportation efforts. Disturbed contaminated soil could enter the ambient air during excavation and transportation. However, dust suppression would be implemented for the protection of the community and workers during the remedial action. These Alternatives would require several years to implement for all affected residences. However, the length of time at any one residence during excavation would be minimal, and is estimated to be approximately 5 days. Therefore, the potential exposure to contaminated dust by any particular resident would be negligible. However, under Alternative 3, soil excavation at each residence could be up to twice as long, or approximately 10 days due to the depth of excavation being twice as deep as the excavation depth prescribed for Alternative 2.

6. Implementability: Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Alternatives 2 and 3 are readily implementable because it is technically feasible from an engineering perspective. Excavation methods, backfilling, and revegetation are typical and easy engineering controls. Excavation and replacement of contaminated surface soil is performed using conventional earth moving equipment and hand tools, and can be readily performed by trained operators and laborers. The experience of previous Site removal actions conducted by EPA at this and other lead mining Superfund sites has shown that the construction component of Alternatives 2 and 3 are readily implementable.

The distribution of vacuum cleaners to occupants of remediated residences as well as the health education component of Alternatives 2 and 3 are readily implementable and have been successfully implemented at other lead mining sites in the region.

The ICs are also implementable components of Alternatives 2 and 3. Coordination between federal, state, county, and local governments and interested citizens is required to discuss and evaluate proprietary controls, such as deed notices, restrictive covenants, and easements; and local governmental controls such as ordinances, building permit restrictions, and builder and developer certifications that require specific training on best management practices when developing properties potentially impacted by historical mining practices.

7. <u>Cost</u>: Includes estimated capital costs as well as present worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

The present worth cost for Alternative 2 is estimated to be $2.23 million (see Documentation of Significant Changes section below). The present worth cost for Alternative 3 is estimated to be $3.13 million. For both cost estimates, capital costs are spread over a construction period of three years. A 7 percent discount rate was used to calculate present worth. These estimates are approximate and made without detailed engineering data. The actual cost of the project would depend on the final scope of the remedial action, actual length of time required to implement the alternative, and other unknown factors.

The historical average amount of soil removed from each residential property during recent time-critical removal actions is 556 yd^3 at a contractor cost of $53 per yd^3. The future cost to remediate residential soil may vary somewhat from these past costs. Annual costs of $2,925 are estimated for public health education. Annual O&M costs of $11,000 are incorporated in the total project cost estimates for only three years, but will be incurred in perpetuity.

8. <u>State/Support Agency Acceptance</u>: This criterion considers whether the state agrees with EPA's analyses and recommendations of the RI/FS and the ROD.

In a letter dated July 13, 2010, MDNR indicated concurrence with the Proposed Plan for the Washington County Lead District, OU1, and in a letter dated August 23, 2011, indicated concurrence with the ROD

9. <u>Community Acceptance</u>: This criterion considers whether the local community agrees with EPA's analyses and Preferred Alternative from the Proposed Plan. Comments received on the Proposed Plan are important indicators of community acceptance.

In general, the local community, including local citizens and officials, support the Selected Remedy (generally presented in the Proposed Plan as the Preferred Alternative). A Responsiveness Summary, which captures public comments has been included as part of the ROD. The landowner of the Indian Creek tailings pile is currently willing to allow its continued use as a soil repository for lead-contaminated soils.

PRINCIPLE THREAT WASTES

According to the Office of Solid Waste and Emergency Response's (OSWER) Directive 9380.3-06FS (A Guide to Principal Threat and Low Level Threat Wastes) dated November 1991, "Principle threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur." Based on this definition, contaminated residential soil does not appear to be a principal threat waste because it is not a source material. The mine waste at the Site is the ultimate source of the lead contamination in residential soil and will be addressed later under other RODs. Additionally, the remaining lead-contaminated residential surface soil is neither highly toxic nor highly mobile in part because of previous removal actions. This ROD allows EPA to address the highest priority at the Site—human health risk posed by residential property surface soil—while additional evaluations are performed at other OUs of the Site.

SELECTED REMEDY

Summary of the Rationale for the Selected Remedy

The Selected Remedy is Alternative 2—12-Inch Soil Excavation, Disposal, Vegetative Cover, Health Education, and Institutional Controls. The Selected Remedy was chosen over the other alternatives by EPA because, among other reasons, it will achieve the RAOs and provides the best balance of trade-offs with respect to the nine NCP criteria. Alternative 2 is a continuation of the previous removal actions to excavate and replace lead-contaminated residential surface soil at the Site. Of the two active alternatives which meet the threshold criteria, Alternative 2 is the better of the two alternatives with respect to short-term effectiveness because there will be less potential for exposure to dust generated during soil disturbance activities as compared to Alternative 3. Alternative 2 is also better with respect to cost, as it is estimated to be $902,000 less than Alternative 3. Additionally, at other lead-mining Superfund sites, EPA has met the RAO for lead in soil by employing alternatives similar to Alternative 2 with respect to the key components. Health education and vacuum cleaner distribution will further reduce the exposure to potential exterior lead sources and interior lead dust. Finally, the EPA will help develop workable and successful ICs with input from the community and government stakeholders. ICs being considered include deed notices, local governmental controls such as building permit restrictions, restrictive covenants, and builder and developer certifications that require specific training on best management practices when developing potential properties impacted by historical mining practices. Ultimately, ICs are needed by EPA to ensure that any physical marker barriers placed at depth are not disturbed for long-term protection of human health.

The HHRA, which is the basis for the RAOs, clearly supports the need to take action at these high priority areas (residential properties) as soon as possible. Thus, it is important not to delay the remedial action to address other issues, such as distributing vacuum cleaners, and implementing health education and ICs. Due to the large number of residential properties requiring remediation, it is estimated to require three years to implement the Selected Remedy.

Description of the Selected Remedy

Alternative 2: Excavation, Disposal, Vegetative Cover, and Institutional Controls
Estimated Total Capital Cost: $2.44 million
Estimated Annual O&M Cost Range: $11,000
Estimated Present Worth Cost: $2.23 million
Estimated Construction Time Frame: 3 years
Estimated Time to Achieve RAOs: 3 years

Under this alternative, residential properties with at least one quadrant surface soil sample testing greater than 400 ppm for lead will have that quadrant and possibly drip zones remediated. The drip zone would be remediated if the composite lead concentration in the drip zone is greater than 400 ppm. Residential properties where no quadrant samples exceed 400 ppm lead would not be addressed under this action. Under this alternative, approximately 79 residential properties contain or are expected to contain lead surface soil concentrations greater than 400 ppm and will require remediation.

Approximately 176 residential properties at the Site have not had their surface soil sampled by EPA. Under this alternative, EPA will continue to seek access to and sample all residential properties at the Site to determine if they have been impacted by mining-related activities. If a surface soil sample in a property's quadrant has a lead concentration greater than 400 ppm, the property will be included in the remedial action.

Excavation: This alternative includes the excavation and removal of lead-contaminated surface soil, backfilling the excavation with clean soil, and seeding. Excavation of a residential property would be triggered when the highest recorded surface soil sample for any defined area of the property contains greater than 400 ppm lead. Soil would be excavated using limited size and lightweight excavation equipment and hand tools in the portions of the property where the surface soil exceeds 400 ppm lead. Excavation will continue in depth until the underlying soil at the bottom of the excavation is less than 400 ppm lead or to a maximum depth of 12 inches bgs, whichever is less. An exception is garden areas, where the maximum depth of excavation will be 24 inches bgs.

If at 12 inches bgs the lead soil concentration is greater than 1,200 ppm, EPA will place a visible marker barrier at 12 inches bgs. The barrier placed will be a visible plastic barrier (such as an orange-mesh plastic sheet) that is permeable, wide meshed, and will not affect soil hydrology or vegetation. The physical barrier will function as a visual warning that digging lower will result in exposure to soil contaminated at a level that EPA has determined to be a human health concern. EPA recommends a minimum of 12 inches of clean soil be used as an adequate soil barrier from soil contaminated above the cleanup level for the protection of human health. The rationale for establishing a minimum clean soil thickness of 12 inches is that the top 12 inches of soil is considered available for direct human contact. Clean fill and topsoil would be used to replace soil removed after excavation, returning the residential property to its original elevation and grade. Clean fill and topsoil means, at a minimum, containing a lead level less than 150 ppm, an arsenic level less than 19 ppm, a cadmium level less than 16 ppm, and a barium level less than 7,500 ppm.

As indicated earlier, EPA estimates that 79 residences have been or will be discovered to have lead concentrations in surface soil greater than 400 ppm. Based on EPA's previous soil removal activities at the Site, an average residential property will require removal and replacement of 500 yd^3 of soil. Therefore, an estimated total of approximately 39,500 yd^3 of soil would require excavation, disposal, and replacement. This estimated total is used as the basis for part of the cost estimate for this remedial action.

Disposal: The excavated soil will be disposed of at the Indian Creek tailings pile, which is to be used as a repository. The EPA has previously used the Indian Creek tailings pile for disposal of excavated lead-contaminated soil under the authority of a Remedial Action Plan Permit (RAP). The current permitted capacity of the repository at Indian Creek is 500,000 yd^3 and the RAP will need to be amended prior to acceptance of all of the soils projected to be generated under the Selected Remedy. For contaminated soil which would fail the TCLP analysis, a lead stabilization compound will be added to the soil at the residential property until the soil meets the TCLP maximum concentration for lead. Regulatory requirements for disposal of the soil at the repository will be followed.

Revegetation: After the topsoil has been replaced, properties would be hydroseeded to restore the vegetation. Hydroseeding is preferred over sodding for its ease of initial maintenance and significant cost reduction. However, sod may be used in areas of properties with steep slopes that would be subject to erosion before the vegetation could become established.

Health Education: Due to the environmental problems of lead and other metals at the Site, health education will be needed during the response actions to help reduce exposures that could potentially lead to adverse health effects. An active educational program would be conducted in cooperation with EPA, ATSDR, MDNR, MDHSS, and the Washington County Health Department. The following, although not an exhaustive list, indicates the types of education activities that may be conducted at the Site.

- Performing in-home assessments for children identified with elevated blood lead levels
- Holding meetings with and acting as a resource for area physicians of local families
- Providing community education through meetings, talks, and presentations at civic clubs, schools, nurseries, preschools, churches, fairs, etc.; and one-on-one family assistance
- Undertaking special projects to increase awareness of how local citizens can protect themselves from lead exposure health risks
- Door-to-door distribution of HEPA vacuum cleaners to residences and providing household cleaning and exposure reduction instruction.

Institutional Controls: With regard to the physical barriers that have been and may be put down at depth in residential properties during the previous removal actions and the upcoming remedial action, respectively, EPA will need to ensure that the barriers and the soil below them are not disturbed for long-term protection of human health. Typically, EPA has looked to various types of ICs to ensure the remedy's long-term protectiveness. While EPA has considered proprietary controls such as restrictive covenants at similar sites, these controls present a great difficulty at this Site given the large number of residential properties that may be covered by the remedy. However, EPA will continue to evaluate the feasibility of these controls as the remedial action selected in the ROD is being implemented.

Governmental controls such as an ordinance requiring permits for earthmoving activities and restricting soil use in areas of known heavy metal contamination at depth would be an efficient and effective control measure. Collaboration and evaluation with the state of Missouri, Washington County Health Department, and other local governments regarding ICs will need to be initiated.

EPA will work with state and local governments to develop and implement ICs. Some of these controls would address protection of any physical marker barriers laid down at depth at residential properties during the upcoming remedial action. However, it could also include building permits for potentially mining-contaminated properties, administrative listing for the county to restrict digging at contaminated properties, builder and developer education when dealing with heavy metal soil contamination, and best management practices for construction work undertaken at potentially mining-contaminated properties.

Summary of the Estimated Remedy Costs

The present worth cost for Alternative 2 is estimated to be $2.23 million and is presented in Table 9. The capital costs are spread over a construction period of three years. A present worth analysis was performed to evaluate project costs over three years and is included in the Table 9. This estimate is approximate and made without detailed engineering data. The information in Table 9 is based on the best available information regarding the anticipated scope of the Selected Remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the implementation of the remedial action. Major changes, if they arise, may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or an amendment to this ROD. This is an order-of-magnitude engineering cost estimate that is expected to be accurate within +50 to -30 percent of the actual project cost.

Expected Outcomes of the Selected Remedy

The Selected Remedy will provide an accelerated response to residential property surface soil contaminated with lead above the cleanup level and will significantly improve human health protection in the community. The cleanup level of 400 ppm lead in surface soil is based on the HHRA and RAOs. The Selected Remedy will take an estimated three years to implement due to the large number of properties involved. The strategy allows for further assessment of the other OUs at the Site, while exposure to lead in surface soil at residential properties, which poses the highest human health risk, is remediated through the well-demonstrated approach of excavation and soil replacement. The Selected Remedy at properties where barriers are placed at depth will ultimately be protected by IC development.

Regarding future land use of the remediated residential properties, continued residential use is anticipated. With adequate IC development, the land use will actually be enhanced because lead-contaminated surface soil that would pose a human health risk will be excavated from the large majority of residential properties. For residential properties where a physical barrier will be placed at depth and an IC put in place to protect the barrier, the upper 12 inches of soil at least would be available for direct human contact under this alternative.

STATUTORY DETERMINATIONS

EPA expects the Selected Remedy to satisfy the following statutory requirement of section 121(b) of CERCLA: (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element or explain why the preference for treatment will not be met. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy will protect human health and the environment at remediated residential properties by achieving the RAOs through a well-demonstrated approach using conventional engineering measures. Risks associated with lead-contaminated residential soil at the Site are caused by the potential for direct contact with contaminated surface soil. The Selected Remedy eliminates this direct exposure pathway through excavation and replacement of lead-contaminated surface soil at the residential properties. Contaminated surface soil will be removed from residential properties, up to a depth of 12 inches bgs, except in existing vegetable gardens where it will be removed up to 24 inches bgs. The implementation of the Selected Remedy will not pose unacceptable short-term risks or cross-media impacts.

Compliance with ARARs

The Selected Remedy is expected to meet all chemical-specific, action-specific, and location-specific ARARs and does not involve any waivers. Because there are many ARARs, the ARARs for this ROD are included in Tables 3 through 8.

The soil repository at St. Joe Minerals – Indian Creek Mine (EPA ID No. MOD 000 669 150) is not currently located within the site boundaries and, therefore, not subject to ARARs. However, the soil repository is regulated under a Missouri State Operating Permit (General Permit No. MO-Rl08652) for Construction or Land Disturbance, a State Operating Permit (MO-0136654) for storm water management and a Remedial Action Plan (issued by EPA February 2007) for treatment, storage and disposal of hazardous remediation waste (as defined by 40 CFR § 260.10). The EPA will also comply with the Off-site Rule pursuant to CERCLA § 121(d)(3) and 40 CFR § 300.440.

Cost Effectiveness

The Selected Remedy is a cost-effective solution to lead-contaminated residential surface soil at the Site. The cost difference between the Selected Remedy (Alternative 2) at approximately $2.23 million and the other alternative that meets the threshold criteria (Alternative 3) at approximately $3.13 million is $902,000 or 29 percent. The excavation and replacement of contaminated surface soil in the Selected Remedy has the highest level of short- and long-term effectiveness and permanence of the alternatives evaluated. No treatment technologies were identified that could demonstrate short- or long-term effectiveness and permanence for remediation of residential surface soil at this time. Although not achieved through treatment, the Selected Remedy does result in reduced mobility of site contaminants through engineering controls. The Selected Remedy relies on conventional engineering methods that are easily implemented. Contaminated surface soil is removed and replaced, thereby providing a permanent remedy for remediated residential surface soil which will not be subject to future costs.

Utilization of Permanent Solutions and Alternate Treatment Technologies to the Maximum Extent Practicable

The Selected Remedy uses a well-demonstrated remediation approach to lead-contaminated surface soil that will provide a permanent remedy for residential soil. Removal and replacement of contaminated residential surface soil permanently removes heavy metal contaminants as a potential source of exposure to residents and children in particular. For a subset of excavated contaminated residential soil, lead stabilization treatment is needed to prevent the soil from failing TCLP. However, the volume of this soil is not expected to be a significant portion of the excavated residential soil. No treatment technologies were identified that could be considered reliable at this time. The ICs and health education will add to the long-term effectiveness for this Site.

Preference for Treatment

The Selected Remedy does not utilize treatment to address the risks posed by the residential property surface soil. No treatment technologies were identified that have definitively demonstrated the ability to reliably provide short- and long-term effectiveness, permanence, and meet the other NCP criteria. The Agency considered phosphate treatment for reducing the risk of exposure to lead in soils during the screening phase of development of the FS and eliminated this technology from further consideration as a remedial alternative. At that time, extended study of the phosphate treatment of soils at the Oronogo-Duenweg Superfund site in Jasper County, Missouri, had achieved a maximum of 40 percent reduction in bioavailability over a seven year study period. However, the technology had not undergone any implementability testing at a residential property by EPA. A recent review of the technology at the Omaha Lead Site entitled "Evaluation of Phosphate Treatment at Residential Properties; Omaha Lead Site, Omaha, Nebraska" had indicated concern about implementability, cost effectiveness and community acceptance in a residential setting, as well as the long-term presence and monitoring of lead in the soil even if its bioavailability has been reduced. Based on these studies and the similarity in sites, the EPA concluded that phosphate treatment of residential soils contaminated with lead would no longer be considered for evaluation as a remedial alternative for OU-1. For a subset of excavated contaminated residential soil, lead stabilization treatment is needed to prevent the soil from failing TCLP. However, the volume of this soil is not expected to be a significant portion of the excavated residential soil.

Based upon the information currently available, the EPA believes the Selected Remedy meets the threshold criteria and provides the best balance of trade-offs among the other alternatives with respect to the balancing and modifying criteria. The EPA concludes that the Selected Remedy satisfies the following statutory requirement of section 121(b) of CERCLA: (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element or explain why the preference for treatment will not be met.

Five-Year Review Requirements

At remediated residential properties where no physical barriers are placed at depth, the Selected Remedy does not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. However, at properties where barriers are placed at depth, lead is left on-site at levels that do not allow unlimited use and unrestricted exposure. Additionally, the consolidation of the lead-contaminated residential soil on the Indian Creek tailings pile and potentially other repositories means that contamination will be left at the Site. Therefore, the selected remedy is subject to periodic five-year reviews in accordance with section 121(c) of CERCLA and the NCP at 40 CFR § 300.430(f)(5)(iii)(C).

DOCUMENTATION OF SIGNIFICANT CHANGES

The total estimated number of residential properties that will require remediation under this ROD is currently 79. The Proposed Plan had overestimated the number of residential properties to be remediated at 98. The overestimation was due to inclusion of 19 properties that had previously been remediated through time–critical removal actions. Cost estimates for the selected remedy and Alternative 3 have been adjusted for this change in estimated properties to be remediated. This change has resulted in the lowering of the estimated cost of the selected remedy by $490,000, from $2.87 million to $2.38 million.

In addition, the discount rate for calculating the total present worth of Alternatives 2 and 3 was changed from 2.7 percent to 7 percent. This caused the present worth cost estimate for selected remedy to be further reduced from $2.38 million to $2.23 million.

The soil cleanup level was incorrectly calculated in the HHRA. Using the correct calculation changes the soil cleanup level in the HHRA from 466 ppm lead to 493 ppm lead. However, this change does not affect the number of properties to be remediated or the estimated cost of the remediation as a risk management decision was made by EPA to use the default cleanup level of 400 ppm lead for the site. Additional information and the technical discussion on this change can be found in the Responsiveness Summary for the Record of Decision below on pages 39 and 40.

GLOSSARY OF TERMS

This glossary defines many of the technical terms used in relation to the Washington County Lead District – Richwoods Site in this ROD. The terms and abbreviations contained in this glossary are often defined in the context of hazardous waste management and apply specifically to work performed under the Superfund program. Therefore, these terms may have other meanings when used in a different context.

Administrative Record (AR): All documents which EPA considers or relies upon in selecting the response action at a Superfund site, culminating in the Record of Decision for remedial action.

Baseline Human Health Risk Assessment (HHRA): A document that provides an evaluation of the potential threat to human health in the absence of any remedial action.

Bioavailability: A risk assessment term; the fraction of an ingested dose that crosses the gastrointestinal epithelium in the stomach and becomes available for distribution to internal target tissues and organs.

Blood lead level or concentration: The concentration of lead in the blood, measured in micrograms of lead per deciliter of blood (μg/dL).

Capital Cost: Direct (construction) and indirect (nonconstruction and overhead) costs including expenditures for equipment, labor, and materials necessary to implement remedial actions.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The acts created a special tax that went into the Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, EPA can either; (1) pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work, or (2) take legal action to force parties responsible for site contamination to clean up the site or pay back the federal government the cost of the cleanup.

Contaminant: Any physical, chemical, biological, or radiological substance or matter that can have an adverse effect on human health or environmental receptors.

Contaminant of Concern (COC): A substance detected at a hazardous waste site that has the potential to affect receptors adversely due to its concentration, distribution, and mode of toxicity.

Discount rate: A percentage rate used in present worth analyses to identify the cost of capital and operation and maintenance expenses. It is used to value a project using the concepts of the time-value of money where future cash flows are estimated and discounted to give them a present value.

Dolomite: A sedimentary rock containing greater than 50 percent of the mineral dolomite; often found with calcite in forming limestone, another sedimentary rock.

Exposure pathways: The course a chemical or physical agent takes from a source to an exposed organism. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route.

Feasibility Study (FS): A report that analyzes the practicability of potential remedial actions; i.e., a description and analysis of potential cleanup alternatives for a site on the National Priorities List.

Groundwater: Water filling spaces between soil, sand, rock and gravel particles beneath the earth's surface, which often serves as a source of drinking water.

National Contingency Plan (NCP): The federal regulation that guides the Superfund program.

National Priorities List: EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System.

Operation and Maintenance (O&M): Activities conducted at a site after response actions occur to ensure that the cleanup or containment system continues to be effective.

Present worth: The amount of money necessary to secure the promise of future payment or series of payments at an assumed interest rate.

Proposed Plan: A plan for a site cleanup that is available to the public for comment which summarizes remedy alternatives and presents EPA's Preferred Alternative or cleanup approach.

Quadrant sample: A composite surface soil sample collected from a portion (usually one quarter) of a residential property.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at a National Priorities List site.

Remedial action: The actual construction or implementation phase of a Superfund site cleanup.

Remedial Investigation (RI): An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site, establish site cleanup criteria, identify preliminary alternatives for remedial action, and support technical and cost analyses of alternatives. The remedial investigation is usually done with the feasibility study. Together they are usually referred to as the RI/FS.

Removal action: Short-term immediate actions taken to address releases of hazardous substances that require an expedited response.

Responsiveness Summary: A summary of oral and/or written public comments received by EPA during a comment period on key EPA documents and EPA's response to those comments.

Toxicity: The degree to which a chemical substance (or physical agent) elicits a deleterious or adverse effect upon the biological system of an organism exposed to the substance over a designated time period.

RESPONSIVENESS SUMMARY FOR THE RECORD OF DECISION
Residential Property Surface Soil (OU-1)
Washington County Lead District - Richwoods Superfund Site
Washington County, Missouri

This Responsiveness Summary has been prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Contingency Plan (NCP), 40 CFR § 300.430(f). This document provides the United States Environmental Protection Agency's (EPA's) response to all significant comments received from the public on the Proposed Plan for the residential properties portion of the Washington County Lead District-Richwoods Superfund Site (Site) during the comment period.

The Responsiveness Summary consists of the following three components: an overview of the public process, stakeholder issues and EPA responses, and technical and legal issues and EPA responses. This document is provided to accompany the Record of Decision (ROD) and reflects input resulting from the public comment process.

Overview

The Proposed Plan and supporting documents included in the Administrative Record (AR) file were made available for public review and comment from July 20 to December 1, 2010. A public meeting was held at the Richwoods R-VII Elementary School in Richwoods, Missouri, on July 21, 2010, with 11 local officials and citizens in attendance. The transcript from the public meeting is included in the AR. This Responsiveness Summary contains a summary of significant public comments and EPA responses.

Stakeholder Issues and EPA Responses:

Comments from the Mayor of Potosi:

> *The Mayor of Potosi requested that EPA provide the training qualifications required for people to perform the work described in the recommended alternative of the Proposed Plan.*

The primary training that is required for individuals to perform remediation work at the Site is the Occupational Safety and Health Administration (OSHA) health and safety training described in 29 CFR Part 1910.120(e). The training requirements are extensive, but in general a worker engaged in the cleanup of hazardous substances needs to complete 40 hours of certified training prior to performing on-site work.

> *The Mayor of Potosi commented that Washington County was an economically distressed county and asked if any future contracts associated the future remedial action could include an incentive to hire locally that was greater than 2 percent.*

While restoring the local economy is not a remedial action as defined by CERCLA, the EPA recognizes the opportunity for communities to benefit economically from the implementation of response actions at Superfund Sites. The EPA believes that a 1 or 2 percent incentive to hire locally on a multi-million dollar contract is a significant incentive in terms of dollars. EPA's experience with site specific remediation contracts in the region has been that the winning bid contractors make a significant effort to meet this incentive criteria. The EPA currently intends to continue including a local hire incentive in its remediation contracts in the region.

The Mayor of Potosi asked a series of questions that related to compensation for road damages and if the Proposed Plan included a settlement procedure for road damages attributable to the implementation of the selected remedy.

The Proposed Plan and ROD do not include a settlement procedure for road damages incurred during the implementation of the selected remedy. The EPA recognizes the potential for damage to the City of Potosi's streets associated with the remedial action. The EPA will work to minimize the potential for damage to city streets, and will work with the City of Potosi should any damage occur that is above and beyond damage caused by normal traffic within the City.

The Mayor of Potosi asked if there would be a record maintained for properties that have soil lead contamination remaining below the 12-inch depth of excavation.

The EPA will maintain a record of this information and provide each property owner with a record of their individual property records. A Site wide data base of soil lead contamination and remediation could be developed and provided to the local governments as part of the future institutional controls for the Site. This needs to be evaluated through a collaborative effort with the local governments and community members.

The Mayor of Potosi asked how active EPA is in implementing institutional controls, and could examples of institutional controls be provided. Related to this comment, State Representative Belinda Harris submitted an inquiry to EPA that asked what other counties and cities are doing to keep track of EPA remediation at other lead cleanup sites to ensure that future homeowners are knowledgeable of past remediation.

The EPA is in the early developmental stage of establishing institutional controls for lead mining and smelting sites within the region in Madison and Jasper County, Missouri, and Douglas County, Nebraska. However, the Bunker Hill Superfund Site, located outside of the region, provides an example of what other local governmental bodies have accomplished in ensuring that future homeowners are knowledgeable of past remediation. The Bunker Hill Superfund Site consists of extensive lead contamination due to past mining activity. The State of Idaho has divided the state into 7 health districts that include multiple counties. The Panhandle Health District in Idaho has developed institutional controls associated with lead contaminated soils at the Bunker Hill Superfund Site. The institutional controls provide information on where contaminants are located and how to avoid exposure, soil sampling assistance, a disposal area for small quantities of contaminated soil removed from properties, and clean backfill soil for properties. You can learn more about these institutional controls at http://www.phd1.idaho.gov/institutional/institutionalindex.cfm

The Mayor of Potosi commented that the Institutional Controls would inhibit development in the community and are an unfunded mandate by the federal government that would have to be implemented by local governments.

EPA's mission is to protect human health and the environment. The response actions identified in this ROD ensure that residents are not exposed to elevated concentrations of lead in residential soils. Although it is uncertain whether future institutional controls such as restrictions on soil movement would inhibit development in the area, Site conditions and the EPA's mission of protecting public health necessitate that some form of institutional controls be implemented in order to warn citizens of the potential exposure risks to lead-contaminated soil remaining at the Site. The cost estimate for the selected remedy in the ROD includes funding for the distribution of an annual mailing which is considered a part of institutional controls. Any additional institutional controls that would be developed are not anticipated to be funded by EPA.

The Mayor of Potosi asked if the EPA had investigated the barite mine waste areas at the Washington County Lead District sites.

The EPA has conducted minimal sampling of the barite mine wastes present at the Washington County Lead District Sites. EPA has directed its resources towards addressing the portions of the Sites (residential soils and drinking water) that pose the most significant public health threat. EPA's future plans include identifying and remediating (if necessary) barite mine tailings.

The Mayor of Potosi suggested that funding should be provided to allow for local government to conduct future sampling at the Washington County Lead District Sites.

This suggestion should be considered during the development of the health education and institutional controls components of the selected remedies for the sites.

Comment from State Representatives:

State Representative Belinda Harris asked if future EPA remediation contracts could include a disincentive for contractors not utilizing local resources.

Past EPA remediation contracts have included disincentives for safety violations and construction procedure errors, but have not utilized disincentives for failure to use local resources because in some instances the local resources are not available. Sometimes a contractor needs to use a specialized or proprietary piece of equipment or material that is not available locally. The EPA believes it would be unfair and inappropriate to levy punitive measures on a contractor under circumstances where a material or service was not locally available.

State Representative Harris asked if the Doe Run Resources Company or another responsible party was going to fund the recommended alternative for remedial action at the Site.

The EPA has no information at this time that would indicate the Doe Run Resources Company is a responsible party at this Site. The EPA continues to investigate the Site for potentially responsible parties (PRPs), but at this time the remedial action would be funded by the general fund of the federal government unless PRPs are identified who are willing to perform the remedial action or portions thereof.

State Representative Harris asked if there were any known smelters or processing plants in the Richwoods area.

At the public meeting the EPA project manager for the Site responded that he was not aware of any historical lead smelters or processing plants located within the boundaries of the Site. However, upon further review of a Missouri State Lead Smelter Inventory prepared by EPA in 1998, two historical, air-furnace, smelters were identified as being located within the Richwoods Site boundary. One smelter was called the Flynn, J. and M.M. Furnace which was located approximately 3 miles south of the intersection of Highway A and Highway 47. The Smelter Inventory records indicate an air-furnace smelter was operated at this location during the 1870s. The second air furnace smelter known as the Charles Moran Smelter, was located approximately 3 miles east of Richwoods, and also operated during the 1870s. In addition, the EPA Smelter Inventory has identified 14 other smelters that operated in Washington County, Missouri, including one named the Richwoods Furnace, but the locations of the smelters were not precisely identified.

State Representative Harris inquired about the implementation of institutional controls and the methods that will be used to preserve records of cleanups performed at the Old Mines, Potosi and Richwoods sites.

The EPA is currently evaluating the most effective methods for preserving records of residential cleanups. This research has not been completed and EPA will continue to work with local governments to determine the best method or methods to store these records for the future.

Comment from the Missouri Department of Natural Resources:

Leanne Tippet Mosby, Acting Director of the Missouri Department of Natural Resources, supports the Proposed Plan from.

The EPA acknowledges this comment.

Comments from other members of the public:

One commenter asked if EPA had received any recent complaints concerning the use of the Indian Creek Site as a repository for Site soils and if earlier complaints had been reconciled. He also asked if the EPA was continuing to use the Indian Creek Site as a soil repository.

EPA responded verbally at the public meeting that it had not received any recent complaints concerning the soil repository and that previous commenters had either been satisfied with EPA responses or decided not to voice their concerns any longer. However, the EPA had received one email from a citizen on August 19, 2010, that included concern over the disposal of soil at the Indian Creek repository and claimed that the EPA did not comply with federal laws pertaining to the impacts of taking soil to the repository. The EPA has complied with all federal laws pertaining to the disposal of soil at the Indian Creek repository, and will continue to do so in the future. The EPA continues to use the Indian Creek Site as a soil repository for the disposal of lead-contaminated residential soils generated at removal actions in Washington County. The selected remedy in the ROD includes the use of the Indian Creek repository for the disposal of lead-contaminated residential soils.

One commenter asked a series of questions and provided comments concerning the management of the Indian Creek Repository and potential future development on the repository.

The Indian Creek Site will need to be managed in a manner that prevents the future development of certain land uses, particularly residential. A portion of the Indian Creek Site consists of a valley that was filled with millions of pounds of lead-contaminated mine tailings behind a man-made dam. The contaminated soil being taken to the Indian Creek Site will be used to cover the majority of the mine tailings previously left at the site. The soil cover will allow for vegetation to be established on the mine tailings and reduce the potential for releases of mine waste to surface waters via runoff and wind erosion. Surface and groundwater monitoring are currently being implemented at the Indian Creek Site and will need to be continued in the future. Institutional controls to secure the Indian Creek Site and prevent the development of residential land uses on the Indian Creek tailings pile will need to be established to prevent future exposures to the wastes at the site.

A commenter asked if the EPA had a map that provided the distribution of lead across areas of concern.

The EPA has not generated a map of this nature for the Site, but maps showing the locations of contaminated residences are included in the Administrative Record for this ROD.

A commenter asked a series of questions concerning well monitoring and EPA response actions to address groundwater contamination at the site.

This ROD addresses the contaminated residential soils at the Site. The EPA has sampled private drinking water wells for metals contamination at the Site. Where EPA samples have identified well water that has been contaminated with metals at levels exceeding federal drinking water standards, residents have been provided an alternative drinking water source such as bottled water or an under-sink filter. These response actions are temporary, as the EPA plans to develop a more permanent remedy that will be identified in a future Proposed Plan and ROD for contaminated ground water caused by historical mining practices.

A commenter made a series of statements concerning the maker barrier described in the ROD and that was previously used at his residence when soil was removed by the EPA during a time-critical removal action.

It was apparent from the comments that the commenter did not understand the purpose of the marker barrier placed where surface soil excavation is stopped and lead soil concentrations exceed 1,200 ppm at the surface of excavated areas. The marker barrier is intended to serve only as a visual warning to anyone digging on a property that has had previous sampling and remediation performed. The barrier cannot prevent water percolation or lead movement within the soil horizon, nor will it provide a physical barrier that would prevent the exposure to lead-contaminated soil.

One commenter asked a series of questions concerning institutional controls, and whether government would restrict a homeowner from raising his home or building a new home on his property.

Institutional controls have not been developed for the Site. However, EPA contemplates that the institutional controls established for this Site will warn citizens of inherent risks posed by soils potentially contaminated with lead. Institutional controls are intended to educate and warn citizens of the potential for exposure to lead in soil at the Site, and are necessary to implement measures to test soils and organize development in a way that will minimize exposure to lead-contaminated soil. In developing institutional controls, consideration should be given to testing soil for lead prior to moving soil to another location or developing a residential property.

One commenter asked if the gravel in Indian Creek was used for driveway gravel would it pose the same risk of lead exposure as the Tiff gravel common to the Washington County Lead District Sites.

The EPA has limited sediment data from Indian Creek. The EPA contends that any soil or gravel within the boundaries of the sites has the potential to be contaminated with lead at concentrations that could pose a threat to public health under residential exposure scenarios. Although Indian Creek is not within the boundary of the sites, the EPA contends that gravel removed from Indian Creek should be checked for lead prior to using it for driveway rock or other residential settings due to the level of historical lead mining activity in Washington County.

A commenter stated that educating the public about lead exposure risk appears to be the biggest problem.

The EPA contends that educating the community on potential lead exposure is important. Effective education of the community about the potential for lead exposure to mining wastes is an important component of the selected alternative in the ROD. Because lead-contaminated soil will remain at depth at some properties, and because soil and gravel movement will occur during future development, the community needs to be aware of the risk of lead exposure generated from the lead contamination remaining at the Site.

A citizen commented that properties that have been tested and remediated will increase in value.

The EPA has no data to confirm this assertion. The objective of this ROD is to reduce the threat to residents associated with residential lead contamination.

A commenter was concerned about children being exposed to lead by sources other than lead contaminated residential soil.

The Proposed Plan and ROD is based on the potential risks associated with lead contamination in soil. Environmental exposures from groundwater, mine waste piles, surface water and surface water sediment are not included in the Proposed Plan and ROD. Contamination in these media may be addressed in future actions.

A commenter was concerned about compensation for mineral rights.

The lead concentration in residential soil found at this Site is not high enough to be commercially valuable.

A commenter was concerned about domestic waste in streams.

This action addresses lead contamination in residential soil. Discharges of untreated wastewater to creeks or streams should be reported to the Missouri Department of Natural Resources.

A commenter stated that she did not support the proposed plan and would not allow EPA access to her property.

The EPA acknowledges this comment.

A commenter supported the Proposed Plan.

The EPA acknowledges this comment.

Technical and Legal Issues and EPA Responses:

The EPA received comments that were of a technical nature, based upon a review of the Proposed Plan, RI, HHRA, and FS. The comments are summarized below:

The Human Health Risk Assessment Report (HHRA) includes a site-specific adjustment to the soil lead bioavailability, however, there is a math error in the calculation of the bioavailability value. If this value were corrected, the cleanup level would be 493 mg/kg. Further, US EPA's basis for rejecting use of the site-specific bioavailability in selecting a soil lead cleanup level in the Proposed Plans is flawed.

The EPA agrees with the comment that a calculation error was made in converting the measured In Vivo Bioaccessibility (IVBA) values to estimated Relative Bioavailability (RBA) values of lead in the residential soil samples. The results of the original calculation were presented in Table 3-3 of the Human Health Risk Assessment (HHRA). As indicated in the comment, the original calculation was incorrectly performed with IVBA in units of percent. The calculation should have been performed with each IVBA value converted to decimal fraction, instead of using the value as a percent. The results of the corrected calculations are presented in Revised Table 3-3 (attached).

The corrected RBA values range from 37.1 percent to 71 percent, with an average of 51.1 percent. This is only slightly lower than the average RBA of 53.9 percent that was presented in the original HHRA.

The EPA furthermore agrees that using the corrected RBA of 51.1 percent, the IEUBK model predicts a soil lead cleanup level of 493 mg/kg (see IEUBK Model Results attached).

The EPA does not agree with the remaining portion of the comment which puts forth an argument that bioavailability increases with increasing lead concentration and that RBAs in the range of 41.8 percent to 54.2 percent (with an average of 46.7 percent and a 95 percent upper confidence limit (UCL) of 49.7 percent) would be more appropriate given lead levels below 1200 mg/kg. The comment suggests soil lead cleanup levels of 537 and 505 mg/kg corresponding to the average and 95 UCL RBA, respectively; and states that EPA has no basis to recommend a default soil lead cleanup level over a site-specific value.

The HHRA correctly noted that RBA is independent of soil lead concentration even though Figure 3-3 of the HHRA illustrated a tendency for RBA values to increase as soil lead concentration increases. The HHRA also correctly pointed out that the reason for this tendency in the residential soils was unknown and was inconsequential. Lead bioavailability is not necessarily correlated with soil concentration. As discussed in detail in the EPA's guidance *Estimation of Relative Bioavailability of Lead in Soil and Soil-Like Materials Using In Vivo and In Vitro Methods* (EPA, 2007), the amount of lead which actually enters the body from an ingested medium depends more on the physical-chemical properties of the lead and of the medium rather than the concentration of lead in the medium. For example, lead in soil may exist, at least in part, as poorly water-soluble minerals, and may exist inside particles of inert matrix such as rock or slag of variable size, shape, and association. These are the chemical properties that may tend to influence the absorption (bioavailability) of lead when ingested. Consequently, it is not appropriate to consider the correlation of RBA with soil lead concentration when establishing a cleanup level. Therefore, the EPA does not agree with using a proposed RBA range of 41.8 percent to 54.2 percent (with an average of 46.7 percent and a 95 UCL of 49.7 percent) to develop a soil lead cleanup level. Such an approach would not be appropriate because the exclusion of data based on soil concentration has no basis.

Furthermore, the EPA considered the variability in the measured IVBA values in its risk management decision to select the default cleanup level for lead. The measured IVBA values ranged from a low of 45.5 percent up to a high of 84.1 percent. This range suggests that the physical-chemical properties that influence bioavailability are highly variable at the residential properties in the Washington County Lead District. This may be due to the variable nature of the source material (mine waste) from which the soil lead was derived. Although it was appropriate to use a site-specific RBA in the characterization of risk in the HHRA, the EPA determined that the application of a site-specific RBA in the development of a cleanup level for the range of residential properties at the Washington County Lead District would not be protective of residences with soils that are associated with higher bioavailability. It is consistent with the EPA's practice to use a default cleanup level to provide protection to the exposed population.

In conclusion, the EPA's selection of the default soil lead cleanup level for the residential soils at the Washington County Lead District Site (which incorporates the default RBA) is justified.

> *The HHRA calculated a site-specific soil-to-dust transfer value but then did not use it in the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) modeling. If it had been used (which would be appropriate according to guidance), this*

would have yielded a soil lead cleanup level of 728 mg/kg. US EPA's basis for rejecting use of the site-specific soil-to-dust transfer value in selecting a soil lead cleanup level in the Proposed Plans is flawed.

This comment states that the EPA's basis for rejecting use of the site-specific soil-to-dust transfer value (M_{sd}) in selecting a soil lead cleanup level in the Proposed Plan is flawed. The comment suggests that a site-specific M_{sd} of 0.209 is appropriate for the Washington County Lead District and that use of this value would have yielded a soil lead cleanup level of 728 mg/kg.

The EPA disagrees with the comment that a site-specific soil-to-dust transfer coefficient (M_{sd}) value be incorporated in the calculation of a site-specific soil lead cleanup level. The development of a site-specific soil lead cleanup level that would be based on a site-specific M_{sd} derived from the Washington County Lead District indoor dust data would not be protective of residential homes with children.

The IEUBK model incorporates a soil-to-dust transfer factor to describe the potential for lead in soil to be transported indoors and contribute to the concentration of lead in dust. This transfer factor is called the M_{sd} and it is defined as the mass fraction of soil-derived particles in indoor dust Since the presence of children under the age of 7 is considered to be one of the main factors affecting soil deposition rates in homes (USEPA, 2008), the use of an M_{sd} that does not reflect the presence of children in the home would violate a major assumption of the IEUBK model. Using indoor dust data from homes not reflective of the presence of young children would underestimate risk and would be expected to generate higher cleanup levels than would be protective of children. Therefore, an M_{sd} that is not reflective of the presence of young children is inappropriate, and should not be used.

The dataset for the Washington County Lead District HHRA consists of measured indoor dust in 48 residential homes. Information collected at the time of sampling through personal interviews documented that children under the age of 7 years were present in only 7 of the 48 homes that were sampled. Furthermore, 4 of these homes only had the presence of grandchildren (who are not primary residents). Only 3 homes had children under the age of 7 years as primary residents.

The Washington County Lead District dataset of measured M_{sd} values is highly variable, ranging from a low of 0.006 up to a high of 0.854. In addition, M_{sd} values are very poorly correlated with outdoor soil lead concentration. M_{sd} values for the three homes with children as primary residents ranged from 0.131 to 0.767. The M_{sd} values for the 7 homes with children (both grandchildren and primary residents) ranged from 0.023 to 0.854. The data for homes with children exhibit extreme variability, and because of the low sample size, the data was deemed not suitable in developing an appropriate site-specific M_{sd} that could be reasonably applied in the IEUBK model.

Consequently, the EPA decided it was more protective of children's health to select the default M_{sd} to characterize risk associated with lead as presented in the HHRA. In addition, EPA's risk management decision to select the default soil lead cleanup level is consistent with the preference to be protective. Use of a site specific M_{sd} based on the data available would not be protective of homes with children.

In conclusion, the EPA's selection of the default soil lead cleanup level for the residential soils at the Washington County Lead District Site (which incorporates the default M_{sd}) is justified.

The HHRA risks are calculated based on the average soil lead level in a residential yard, but the Proposed Plans call for excavation of any yard with one sample above 400 mg/kg even if the yard average was below 400 mg/kg. This is inconsistent with US EPA guidance, and goes above and beyond what is necessary to achieve the Remedial Action Objectives given in the Proposed Plans.

This comment relates to the EPA's use of individual quadrant samples to determine the need for excavation of contaminated soil. The commenter notes that the IEUBK calculates a cleanup goal for a yard wide average which is inconsistent with excavation of individual quadrants of a residential property.

The EPA uses the Superfund Lead-Contaminated Residential Sites Handbook to guide its' work at lead mining sites. This handbook is used by the EPA as a guide at residential lead sites nationwide. Page 41 of this handbook states that lots larger than 5,000 square feet should be divided into four quadrants and a cleanup decision should be made for each quadrant. Lots in Washington County typically exceed 5,000 square feet in size. Therefore excavating individual quadrants is consistent with the guidance in the handbook. Children may spend more time in a particular area of the yard (e.g., swingset, or designated play area, garden) versus the entire yard. Per guidance, these areas can be evaluated separately or weighted (area or time) into the overall average concentration (USEPA, 2003 & 2007). However, an un-weighted average yard wide concentration is typically calculated and used to evaluate current and future risks given the uncertainties with current and future exposure patterns and behaviors. Although the residential yard is the primary exposure unit of concern, remedial decisions are made for each quadrant (i.e., quadrants exceeding the clean-up level) (USEPA, 2003).

The combination of the bioavailability math error, the omission of site-specific analyses, and application of the cleanup level to individual samples rather than yard averages, results in selection of a significantly greater number of properties for remediation than would be identified in a revised and corrected risk assessment where properties were selected on the basis of unacceptable risk. We estimate that remedial costs could be decreased by approximately $29 million if these flaws are corrected.

This comment draws from the previous three comments and suggests that the estimated number of properties requiring remediation is incorrect. As described in the previous three responses, the EPA has adequately addressed these comments and appropriately estimated the number of properties requiring remediation and remedial costs associated with the remediation.

Arsenic and cobalt concentrations at the sites fall within the range of background concentrations based on comparison to US EPA's combined background data set. Arsenic and cobalt should not be identified as contaminants of concern, soil cleanup levels should not be selected, and no remediation is necessary for arsenic and cobalt.

This comment contends that arsenic and cobalt concentrations at the site fall within the range of background concentrations based on comparisons to the EPA's combined background data set. The comment states that arsenic and cobalt should not be identified as contaminants of concern, soil cleanup levels should not be selected, and no remediation is necessary for arsenic and cobalt.

The data presented in Table 4.1 provided with the comment is not accurate. In some cases, the number of samples and maximum detected values presented in Table 4.1 do not agree with the number of samples and maximum detected values actually in the database for the Washington County Lead District Remedial Investigation. For example, cobalt was detected in 27 out of 27 residential confirmation soil samples; arsenic was detected in 22 out of 27 residential confirmation soil samples. As shown in Table 2.10 of the HHRA for the Potosi area, arsenic was detected in 493 out of 592 soil samples with a maximum detected concentration of 313 mg/kg.

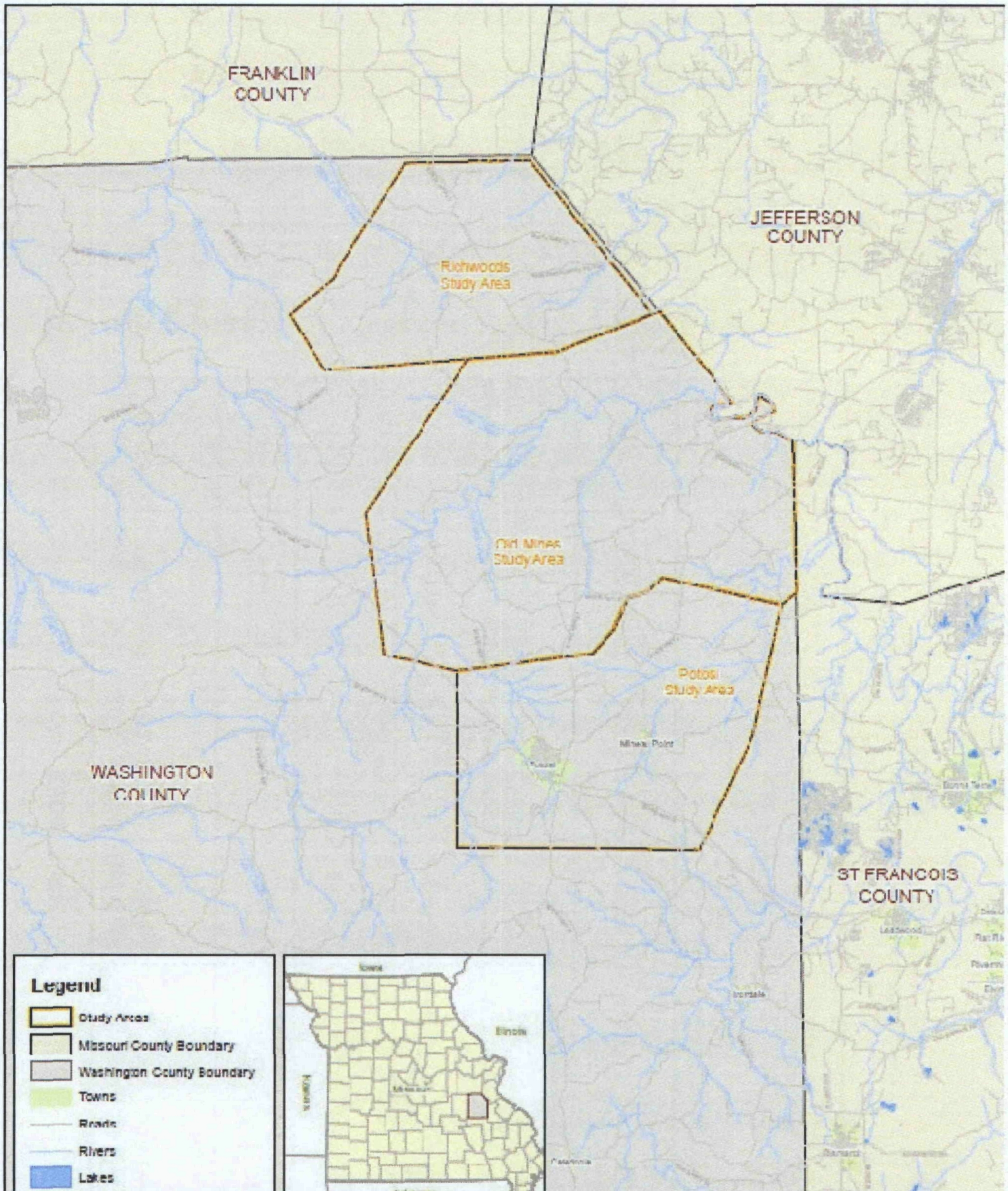
In addition to the errors in the commenter's summary, the statistical tests that were performed on the data were inappropriate. Statistical tests presented (t-test) assume normality and were conducted on the entire residential soil data set. Apparently, no tests were conducted on the data to determine if cobalt and arsenic concentrations are normally distributed, since results of normality tests are not reported. The EPA conducted the Lilliefors Normality Test on the data which concluded that neither arsenic nor cobalt is normally distributed at the 5 percent significance level. Consequently, the results of the t-test are invalid. Furthermore, it is questionable whether statistical tests of any sort can be used to compare the data since arsenic and cobalt were sampled so infrequently in the 48 residential properties that were quantitatively evaluated in the HHRA.

The HHRA appropriately evaluated risks and hazards to both arsenic and cobalt as COPCs. In the quantitative risk assessment, cobalt was selected as a COC for only one residence which had a concentration of 34.9 mg/kg which exceeds the mean concentration of background cobalt (10.5 mg/kg). Arsenic was selected as a COC in the qualitative risk assessment based on soil concentrations present in mine waste and soil (up to 313 mg/kg) well above the risk-based screening level (0.39 mg/kg) and the mean concentration of background arsenic (19.6 mg/kg).

In the Proposed Plans, recommendations for cleanup of arsenic and cobalt are on a site by site basis. Because those residences currently identified with elevated arsenic and cobalt also have elevated lead, remediation efforts to address lead are also expected to address arsenic and cobalt. Although a change could occur due to site-specific data, there are no known residential properties that are currently planned for remediation solely on the basis of elevated arsenic and cobalt concentrations.

In conclusion, EPA's risk management decision to remediate arsenic and cobalt on a site specific basis is justified. In addition to lead, the consideration of these two COCs in cleanup decisions will insure that all risks to residential properties will be addressed by the proposed action.

FIGURE 1 – SITE MAP



N 0 2.5 5 Miles
NAD 1983, UTM, 15N

Note: Adapted from Remedial Investigation 2010 Figure 1-1 Site Location Map Washington County Lead District

FIGURE 2 – SITE CONCEPTUAL MODEL FOR HUMAN EXPOSURE AT THE WASHINGTON COUNTY MINES SITE

		RECEPTORS					
MEDIA	**EXPOSURE PATHWAYS**	**Industrial Worker (Adult)**	**Construction Worker (Adult)**	**Recreational User (Adult/Child)**	**Resident (Adult)**	**Resident (Child)**	**ATV Rider (Adolescent)**
Soil (Mine Waste, Area Wide, Residential)	Dermal Absorption, Ingestion	C/F	C/F	C/F	C/F	C/F	C/F
Agricultural Products/ Homegrown Produce	Ingestion	C/F	C/F	C/F	C/F	C/F	C/F
Groundwater (Area Wide, Residential)	Dermal Absorption, Ingestion	C/F	C/F	C/F	C/F	C/F	C/F
Air (Soil-Derived Dust)	Inhalation	C/F	C/F	C/F	C/F	C/F	C/F
Surface Water	Dermal Absorption, Ingestion	C/F	C/F	C/F	C/F	C/F	C/F
Sediment	Dermal Absorption, Ingestion	C/F	C/F	C/F	C/F	C/F	C/F
Biota (Fish Tissue)	Ingestion	C/F	C/F	C/F	C/F	C/F	C/F

Note: Adapted from HHRA 2010 Figure 3-1b Conceptual Exposure Model (Exposure Pathways) Washington County Lead District Site
(See HHRA text for discussion of which pathways are quantitatively evaluated)

C – Current Use Scenario (Complete Pathway)
F – Future Use Scenario (Complete Pathway)

TABLE 1 – QUANTITATIVE CHEMICALS OF POTENTIAL CONCERN

Chemical of Potential Concern	Exposure Point	
	Soil (Residential Properties)	Potable Well Water (Residential Properties)
Aluminum	X	
Antimony	X	
Arsenic	X	X
Barium	X	X
Cadmium	X	X
Cobalt	X	
Iron	X	
Lead	X	X
Manganese	X	
Vanadium	X	
Zinc	X	

Note: Arsenic retained as a COPC in potable well water based on inadequate detection limits.

Note: Adapted from HHRA 2010 Table 2-1
Chemicals of Potential Concern for
Quantitative Risk Assessment
Washington County Lead District

TABLE 2 –CURRENT RISKS TO CHILDREN FROM INGESTION OF LEAD IN SURFACE SOIL

ESTIMATED NUMBER AND PERCENT OF PROPERTIES WITHIN THE SPECIFIED P10(%) RANGE					
	≤5%	>5% to ≤10%	>10% to ≤20%	>20% to ≤50%	>50%
# Of Properties Out Of 48	16	2	8	17	5
% Of Properties	33	4	17	35	10

Notes:

P10 - Probability of exceeding a blood lead value of 10 µg/dL (%)

Table 3
Federal Chemical-Specific ARARs

	Citations	Description
A. ARARs		
1. Clean Water Act	Water Quality Criteria 40 C.F.R. Part 131 Water Quality Standards	Establishes non-enforceable standards to protect aquatic life. May be relevant and appropriate to surface water discharges.
2. Clean Air Act	National Primary and Secondary Ambient Air Quality Standards 40 C.F.R. Part 50	Establishes standards for ambient air quality to protect public health and welfare.
3. Residential Lead-Based Paint Hazard Reduction Act	Toxic Substances Control Act (TSCA) Disclosure Rule 1018, August 2009 , 40 C.F.R. Part 745.220 Subpart L	Requires persons conducting lead-based paint activities, which includes cleanup of lead-contaminated soil, to follow certification requirements and work practice standards.
B. To Be Considered		
1. EPA Revised Interim Soil-lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities and 1998 Clarification	Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-12, July 14, 1994, OSWER Directive 9200.4-27P, August 1988	Establishes screening levels for lead in soil for residential land use, describes development of site-specific preliminary remediation goals, and describes a plan for soil-lead cleanup at CERCLA sites. This guidance recommends using the EPA Integrated Exposure Uptake Biokinetic Model (IEUBK) on a site-specific basis to assist in developing cleanup goals.
2. EPA Strategy for Reducing Lead Exposures	EPA, February 21, 1991	Presents a strategy to reduce lead exposure, particularly to young children. The strategy was developed to reduce lead exposure to the greatest extent possible. Goals of the strategy are to 1) significantly reduce the incidence above 10 μg Pb/dL in children; and 2) reduce the amount of lead introduced into the environment.
3. Human Health Risk Assessment Report (HHRA)	"Human Health Risk Assessment, Washington County Lead District, Washington County, Missouri" – prepared by Black and Veatch Special Projects Corp., February 2010	Evaluates baseline health risk due to current site exposures and established contaminant levels in environmental media at the site for the protection of public health. The risk assessment approach using this data should be used in determining cleanup levels because ARARs are not available for contaminants in soils.
4. Superfund Lead-Contaminated Residential Sites Handbook	EPA OSWER 9285.7-50, August 2003.	Handbook developed by EPA to promote a nationally consistent decision making process for assessing and managing risks associated with lead contaminated residential sites across the country.

Table 4
State Chemical-Specific ARARs

	Citation	Description
A. ARARs		
1. Missouri Air Conservation Law	Missouri Department of Natural Resources RSMo 643.010 10 CSR 10-6.010	Sets ambient air quality standards for a variety of constituents, including particulate matter and lead. Provides long range goals for ambient air quality throughout Missouri in order to protect the public health and welfare.
2. Hazardous Waste Management Law	Missouri Department of Natural Resources Identification and Listing of Hazardous Waste 10 CSR 25-4.261 (A) 1, 2, 4	Defines those solid wastes which are subject to regulations as hazardous wasters under 10 CSR 25.
3. Missouri Clean Water Law	Missouri Department of Natural Resources RSMo 644.006 10 CSR 20-7.015 (1) (2) (3) (4) (5) (6) (7) (9)	Sets forth the limits for various pollutants which are discharged to the various waters of the state. Sets effluent standards that will protect receiving streams.
4. Missouri Clean Water Law	Missouri Department of Natural Resources RSMo 644.006 10 CSR 20 – 7.031 (2) (3) (4) (5); Tables (A) (B)	Identifies beneficial uses of waters of the State, criteria to protect their uses, and defines the antidegradation policy.
B. To Be Considered	None	

Table 5
Federal Location-Specific ARARs

	Citation	Description
A. ARARs		
1. Historic project owned or controlled by a federal agency	National Historic Preservation Act: 16 U.S.C. 470, et.seq; 40 C.F.R. § 6.301; 36 C.F.R. Part 1.	Property within areas of the Site is included in or eligible for the National Register of Historic Places. The remedial alternatives will be designed to minimize the effect on historic landmarks.
2. Site within an area where action may cause irreparable harm, loss, or destruction of artifacts.	Archeological and Historic Preservation Act; 16 U.S.C. 469, 40 C.F.R. 6.301.	Property within areas of the site may contain historical and archaeological data. The remedial alternative will be designed to minimize the effect on historical and archeological data.
3. Site located in area of critical habitat upon which endangered or threatened species depend.	Endangered Species Act of 1973, 16 U.S.C. 1531-1543; 50 C.F.R. Parts 17; 40 C.F.R. 6.302. Federal Migratory Bird Act; 16 U.S.C. 703-712.	Determination of the presence of endangered or threatened species. The remedial alternatives will be designed to conserve endangered or threatened species and their habitat, including consultation with the Department of Interior if such areas are affected.
4. Site located within a floodplain soil.	Protection of Floodplains, Executive Order 11988; 40 C.F.R. Part 6.302, Appendix A.	Remedial action may take place within a 100-year floodplain. The remedial action will be designed to avoid adversely impacting the floodplain in and around the soil repository to ensure that the action planning and budget reflects consideration of the flood hazards and floodplain management.
5. Wetlands located in and around the site.	Protection of Wetlands; Executive Order 11990; 40 C.F.R. Part 6, Appendix A.	Remedial actions may affect wetlands. The remedial action will be designed to avoid adversely impacting wetlands wherever possible including minimizing wetlands destruction and preserving wetland values.
6. Waters in and around the site.	Clean Water Act, (Section 404 Permits) Dredge or Fill Substantive Requirements, 33 U.S.C. Parts 1251-1376; 40 C.F.R. Parts 230, 231.	Capping, dike stabilization, construction of berms and levees, and disposal of contaminated soil, waste material or dredged material are examples of activities that may involve a discharge of dredge or fill material. Four conditions must be satisfied before dredge and fill is an allowable alternative: 1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation of State water quality standards, violate applicable toxic effluent standards, jeopardize threatened or endangered species or injure a marine sanctuary. 3. No discharge shall be permitted that will cause or contribute to significant degradation of the water. 4. Appropriate steps to minimize adverse effects must be taken. Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.

Table 5 (Continued)
Federal Location-Specific ARARs

A. ARARs (Continued)	Citation	Description
7. Areas containing fish and wildlife habitat.	Fish and Wildlife Conservation Act of 1980, 16 U.S.C. Part 2901 et seq.; 50 C.F.R. Part 83.9 and 16 U.S.C. Part 661, et seq. Federal Migratory Bird Act, 16 U.S.C. Part 703.	Regulates activity affecting wildlife and non-game fish. Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.
8. Fish and Wildlife Coordination Act	16 U.S.C Section 661 et seq.; 33 C.F.R Parts 320-330; 40 C.F.R 6.302	Requires consultation when a Federal department or agency proposes or authorizes any modification of any stream or other water body, and adequate provision for protection of fish and wildlife resources.
9. 100-year floodplain	Location Standard for Hazardous Waste Facilities- RCRA; 42 U.S.C. 6901; 40 C.F.R. 264.18(b).	RCRA hazardous waste treatment and disposal. Facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout during any 100-year/24 hour flood.
10. Historic Site, Buildings, and Antiquities Act	16 USC Section 470 et seq., 40 CFR Sect. 6.301(a), and 36 CRF, Part1.	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks and to avoid undesirable impacts on such landmarks.
B. To Be Considered	None	

Table 6
State Location-Specific ARARs

	Citation	Description
A. ARARs		
1. Missouri Wildlife Code	Missouri Department of Natural Resources 3 CSR Sec. 10 – 4.111	Requires a determination of the presence or absence of endangered or threatened species, and provides for regulation of non-game wildlife. Places restrictions on actions affecting protected species. Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.
B. To Be Considered	None	

Table 7
Federal Action-Specific ARARs

	Citation	Description
A. ARARs		
1. Disposal of Solid Waste in the Permanent Repository and closure of the Removal Repository.	Subtitle D of RCRA, Section 1008, Section 4001, et seq., 42 U.S.C. '6941, et seq.	State or Regional Solid Waste Plans and implementing federal and state regulations to control disposal of solid waste. The yard soils disposed in the repository may not exhibit the toxicity characteristic and therefore, are not hazardous waste. However, these soils may be solid waste. Contaminated residential soils will be consolidated from yards throughout the site into a single location. The disposal of this waste material should be in accordance with regulated solid waste management practices.
2. Clean Water Act	Water Quality Criteria 40 C.F.R. Part 131 Water Quality Standards	Establishes non-enforceable standards to protect aquatic life.
3. Clean Air Act	National Ambient Air Quality Standards/ NESHAPS 42 U.S.C. 74112; 40 C.F.R. 50.6 and 50.12	Emissions standards for particulate matter and lead.
4. Hazardous Materials Transportation Act	Hazardous Materials Transportation Regulations 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous materials.
5. Transportation of excavated soils.	DOT Hazardous Material Transportation Regulations, 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous wastes.
6. NPDES Storm Water Discharge.	40 C.F.R. Part 122.26; 33 U.S.C 402 (p)	Establishes discharge regulations for storm water.
7. Solid Waste Disposal Act	Hazardous Waste Management Systems General 40 C.F.R Part 260 to 268	Establishes procedures and definitions pertaining to solid and hazardous waste.
8. Solid Waste Disposal Act	Identification and Listing of Hazardous Waste 40 C.F.R. Parts 261	Defines those solid wastes that are subject to regulations as hazardous wastes under 40 C.F.R. Parts 262-265 and Parts 124, 270, and 271.
9. Solid Waste Disposal Act	Standards Applicable to Generators of Hazardous Waste 40 C.F.R. Parts 262 to 262.11	Waste Determination.
10. Solid Waste Disposal Act	Standards Applicable to Transporters of Hazardous Wastes 40 C.F.R. Parts 263	Establishes standards that apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 C.F.R. Parts 262.
11. Solid Waste Disposal Act	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities 40 C.F.R. Parts 264 and 265	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities that treat, store, or dispose of hazardous waste.
12. Solid Waste Disposal Act	Land Disposal 40 C.F.R. Parts 268	Establishes a ban or restrictions on burial of wastes and other hazardous materials.

Table 7 (Continued)
Federal Action-Specific ARARs

	Citation	Description
A. ARARs (Continued)		
13. Solid Waste Disposal Act	Hazardous Waste Permit Program 40 C.F.R. Parts 270	Establishes provisions covering RCRA permitting requirements.
14. Waters in and around the site.	Clean Water Act, (Section 404 Permits) Dredge or Fill Substantive Requirements, 33 U.S.C. Parts 1251-1376; 40 C.F.R. Parts 230,231.	Capping, dike stabilization, construction of berms and levees, and disposal of contaminated soil, waste material or dredged material are examples of activities that may involve a discharge of dredge or fill material. Four conditions must be satisfied before dredge and fill is an allowable alternative: 1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation of State water quality standards, violate applicable toxic effluent standards, jeopardize threatened or endangered species or injure a marine sanctuary. 3. No discharge shall be permitted that will cause or contribute to significant degradation of the water. 4. Appropriate steps to minimize adverse effects must be taken. Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.
B. To Be Considered	None	

Table 8
State Action-Specific ARARs

A. ARARs	Citation	Description
1. Missouri Fugitive Particulate Matter Regulations	Missouri Department of Natural Resources 10 CSR 10-6.170	The Missouri fugitive particulate matter regulations contain restrictions on the release of particulate matter to ambient air. These regulations are applicable to any dust emissions that occur as a result of remedial actions taken at the site.
2. Missouri Air Pollution Control Program	10 CSR 10-6.010 et seq.	Ambient concentrations of air pollutants should be less than their respective acceptable ambient levels at the site boundary.
3. Missouri Clean Water Law – Storm Water Regulations	Missouri Department of Natural Resources 10 CSR 20-6.200	These regulations define Best Management Practices for land disturbances, including practices or procedures that would reduce the amount of metals in soils and sediments available for transport to waters of the state. Permits would not be required for actions taken under CERCLA, but the substantive provisions of these regulations would be applicable. The Missouri standards would be considered ARARs only if they are more stringent than the Federal standards. Requires permits for metal and non-metal mining facilities and land uses or disturbances that create point source discharges of storm water.
4. Missouri Clean Water Law – Effluent Regulations	Missouri Department of Natural Resources RSMo 644.006 – 564 10 CSR 20 – 7.015	Regulates the discharge of constituents from any point source, including storm water, into waters of the state. Provides for the maintenance and protection of public health and aquatic life use of surface water and groundwater. The Missouri standards would be considered ARARs only if they are more stringent than the Federal standards. Regulates effluent discharges by limiting the amounts of various pollutants discharged to waters of the state. State permits would not be required under CERCLA, but the substantive provisions would be applicable.
5. Missouri Hazardous Substances Emergency Response	Missouri Department of Natural Resources RSMo 260.520 10 CSR 24-3.010	Establishes a statewide emergency telephone number to notify the State whenever a hazardous substance emergency occurs and specifies the requirements for emergency notification and follow up written notice.
6. Missouri Solid Waste Disposal Law	Missouri Department of Natural Resources RSMo 260.225 10 CSR 80-5.010 (2)	Contains requirements for determining what solid wastes will be accepted at landfills and identifying any special handling requirements.
7. Missouri Solid Waste Disposal Law	Missouri Department of Natural Resources RSMo 260.225 10 CSR 80-5.010 (5) (A), (B) 1-4, (C)	Requires all waters discharged from solid waste processing facilities to be sufficiently treated to meet applicable water quality standards, including those established under the authority of the Federal Water Pollution Control Act.
8. Missouri Hazardous Waste Management Law	Missouri Department of Natural Resources RSMo 260.370 10 CSR 25-5.262	Sets forth standards for generators of hazardous waste, incorporates 40 CFR Part 262 by reference, and sets forth additional state standards.
9. Missouri Hazardous Waste Management Law	Missouri Department of Natural Resources RSMo 260.385 and 260.395 10 CSR 25-6.263	Sets forth standards for transporters of hazardous waste, incorporates 40 CRF Part 263 and certain regulations in 49 CFR by reference, and sets forth additional state standards.
10. Missouri Hazardous Waste Management Law	Missouri Department of Natural Resources RSMo 260.370 , 260.390, and 260.395 10 CSR 25-7.264(2)(A) through (2)(G), (2)(K) through (2)(N), and/or (2)(S)	Sets forth the standards for owners and operators of hazardous waste treatment, storage and disposal facilities; incorporates and modifies the federal regulations in 40 CFR Part 264 by reference, and sets forth additional state requirements.
11. Missouri Hazardous Waste Management Law	Missouri Department of Natural Resources RSMo 260.370, 260.390, 260.395, and 260.400 10 CSR 25-7.268	Establishes standards and requirements that identify hazardous wastes that are restricted from land disposal.
B. To Be Considered	None	

TABLE 9 – SELECTED REMEDY (ALTERNATIVE 2) COST ESTIMATE (RICHWOODS)

Present Worth Cost Estimate

Alternative 2- 12-Inch Soil Excavation, Disposal, Vegetative Cover, and Health Education

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Costs
Capital Costs				
Mobilization	1		$50,000	$50,000
Property Access. Contaminant Assessment	79	Properties	$400	$31,600
Sampling Activities	176	Properties	$600	$105,600
Soil Movement (excavation. transport. backfilll. dust suppression)	39,500	yd^3	$45	$1,777,500
Post Cleanup Reports	79	Properties	$100	$7,900
Vegetative Cover	79	Properties	$855	$67,545
Lead Stabilization	62	Tons SulfiTech	$250	$15,500
Air Monitoring	3	years	$2,800	$8,400
Soil Movement and Grading at Landfill	39,500	yd^3	$1.5	$59,250
Vegetative Cover at Landfill	80	acre	$1,500	$120,000
DIRECT CAPITAL COST SUBTOTAL				$2,243,295
Bid Contingency (5%)				$112,200
Scope Contingency (2%)				$44,900
TOTAL DIRECT CAPITAL COST				$2,400,395
Pemitting and Legal (1%)				$24,000
CONSTRUCTION COST TOTAL				$2,424,395
Engineering Design (.05%)				$12,100
NON-RECURRING CAPITAL COST				$2,436,000

OTHER ANNUAL COSTS			Annual	Total Cost
HEPA vacuums (98 properties @$100 each)	3	year	$3,267	$9,800
Vacuum Distribution/Health Education	3	year	$2,925	$8,775
Institutional Controls (Annual Mailings = 474 total households)	3	year	$711	$2,133
Allowance for Repository Maintenance Cost	3	year	$11,000	$33,000

Discounted Cost for Project Year

Year	Annual Costs	Costs Include:
1	$829,903	
2	$724,869	
3	$677,448	
Total Present Worth of Costs	**$2,232,220**	

Revised Table 3-3
In Vitro Bioaccessibility and Estimated Relative Bioavailability of Lead in Residential Soil Samples
Washington County Lead District RI/FS

ASR #	Sample #	XRF Pb Concentration (mg/kg)	IVBA (%)	RBA (%)
3902	601	5089	76.8	64.6
3902	602	507	53.8	44.4
3902	603	5151	84.1	71.0
3902	604	2367	74.9	63.0
3902	605	1291	60.4	50.2
3902	606	1136	64.9	54.2
3902	607	606	51.8	42.7
3902	608	528	62.5	52.1
3902	609	676	57.5	47.7
3902	610	893	50.8	41.8
3902	611	1349	45.5	37.1
3902	612	1272	71.2	59.7
3902	613	1566	57.4	47.6
3902	614	481	57.0	47.2
3902	615	637	52.6	43.4
minimum		481	45.5	37.1
maximum		5151	84.1	71.0
average		1570	61.4	51.1

IVBA = *In vitro* bioaccessibility
RBA = Relative bioavailability (*In vivo*)
RBA = 0.878*[IVBA] - 0.028
where IVBA is expressed as a decimal fraction

LEAD MODEL FOR WINDOWS Version 1.1

==
Model Version: 1.1 Build9
User Name: EPA
Date: 12/16/2010
Site Name: Washington County Lead District
Operable Unit: OU1
Run Mode: PRG

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 355.100 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700

Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	493.000	355.100
1-2	493.000	355.100
2-3	493.000	355.100
3-4	493.000	355.100
4-5	493.000	355.100
5-6	493.000	355.100
6-7	493.000	355.100

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

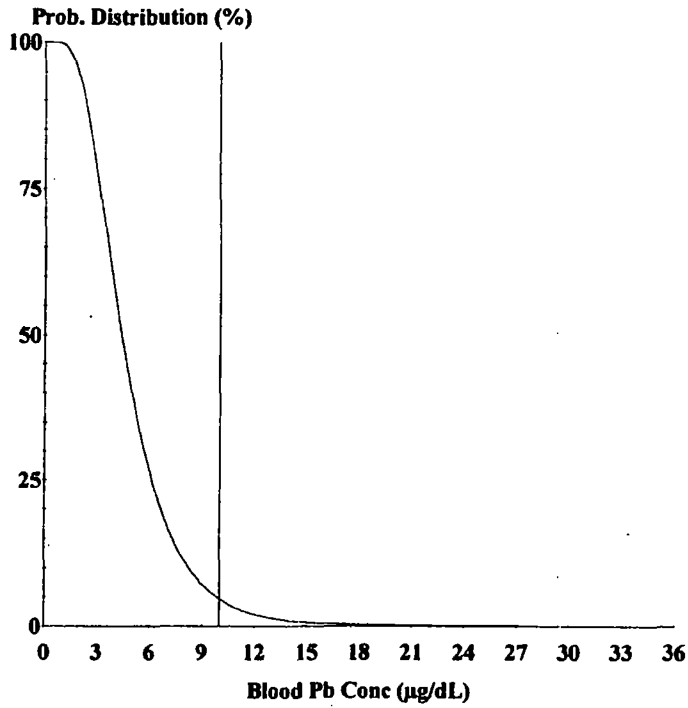
****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.013	0.000	0.359
1-2	0.034	0.862	0.000	0.880
2-3	0.062	0.953	0.000	0.931
3-4	0.067	0.927	0.000	0.963
4-5	0.067	0.913	0.000	1.030
5-6	0.093	0.971	0.000	1.099
6-7	0.093	1.058	0.000	1.124

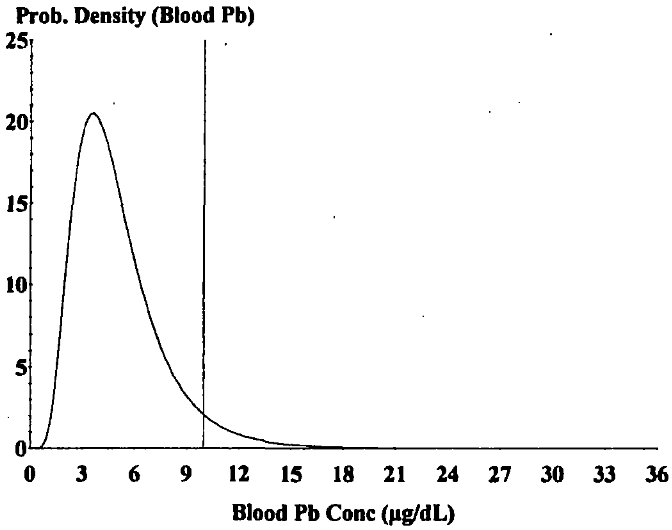
Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	8.108	9.501	5.1
1-2	12.639	14.416	5.9
2-3	12.853	14.799	5.5
3-4	13.049	15.005	5.2
4-5	9.963	11.973	4.3
5-6	9.068	11.231	3.6
6-7	8.616	10.892	3.2



Cutoff = 10.000 µg/dl
Geo Mean = 4.615
GSD = 1.600
% Above = 4.998

Age Range = 0 to 84 months

Run Mode = Research
Comment = Target Soil Lead 493 mg/kg



Cutoff = 10.000 µg/dl
Geo Mean = 4.615
GSD = 1.600
% Above = 4.998
% Below = 95.002

Age Range = 0 to 84 months

Run Mode = Research
Comment = Target Soil Lead 493 mg/kg

Prepared for:
U.S. Environmental Protection Agency
Region 7
901 North 5th Street
Kansas City, Kansas 66101

Results of Statistical Normality Tests
Conducted on
Residential Property Soils

Provided In Response to Comment # 4
on the
Proposed Plan for
Residential Property Soils – Operable Unit 1
Washington County Lead District for the
Potosi, Richwoods, and Old Mines Superfund Sites
Washington County Missouri

Comments Submitted to Office of Public Affairs
EPA Region 7
by Robert N. Steinwurtzel, Bingham McCutchen LLP

Response Prepared by
Black & Veatch Special Projects Corp.
For
USEPA Region 7, Kansas City, Kansas

December 2010

EPA Contract No.: EP-S7-05-06
EPA Task Order No.: 0097
BVSPC Project No.: 044755

BLACK & VEATCH
Building a world of difference.

Prepared by:
Black & Veatch Special Projects Corp.
6601 College Blvd.
Overland Park, Kansas 66211

From File: Sheet1.wst

Summary Statistics for Raw Full Data Sets

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
Arsenic	75	0.25	72	19.55	11	410.2	20.25	13.28	1.109	-0.00109	1.036
Cobalt	54	3	30	10.52	7	32.82	5.729	2.965	1.514	3.035	0.545

Percentiles for Raw Full Data Sets

Variable	NumObs	5%ile	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Arsenic	75	0.947	1.48	2.472	3.625	11	29	35.4	53.4	61.3	68.3
Cobalt	54	5	5	7	7	7	15	15	15	16.75	30

General Background Statistics for Full Data Sets

User Selected Options

From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Cobalt

General Statistics

Total Number of Observations	54	Number of Distinct Observations	7
Tolerance Factor	1.624		

Raw Statistics		**Log-Transformed Statistics**	
Minimum	3	Minimum	1.099
Maximum	30	Maximum	3.401
Second Largest	30	Second Largest	3.401
First Quartile	7	First Quartile	1.946
Median	7	Median	1.946
Third Quartile	15	Third Quartile	2.708
Mean	10.52	Mean	2.227
SD	5.729	SD	0.499
Coefficient of Variation	0.545		
Skewness	1.514		

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.267	Lilliefors Test Statistic	0.25
Lilliefors Critical Value	0.121	Lilliefors Critical Value	0.121
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 90% Coverage	19.82	95% UTL with 90% Coverage	20.86
95% UPL (t)	20.2	95% UPL (t)	21.55
90% Percentile (z)	17.86	90% Percentile (z)	17.58
95% Percentile (z)	19.94	95% Percentile (z)	21.07
99% Percentile (z)	23.85	99% Percentile (z)	29.62

Gamma Distribution Test		**Data Distribution Test**	
k star	3.897	Data do not follow a Discernable Distribution (0.05)	
Theta Star	2.699		
MLE of Mean	10.52		
MLE of Standard Deviation	5.328		
nu star	420.8		
A-D Test Statistic	3.078	**Nonparametric Statistics**	
5% A-D Critical Value	0.754	90% Percentile	15
K-S Test Statistic	0.264	95% Percentile	16.75

5% K-S Critical Value	0.121	99% Percentile	30
Data not Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 90% Coverage	20
90% Percentile	17.66	95% Percentile Bootstrap UTL with 90% Coverage	18.5
95% Percentile	20.53	95% BCA Bootstrap UTL with 90% Coverage	15
99% Percentile	26.67	95% UPL	22.5
		95% Chebyshev UPL	35.72
95% WH Approx. Gamma UPL	20.66	Upper Threshold Limit Based upon IQR	27
95% HW Approx. Gamma UPL	20.82		
95% WH Approx. Gamma UTL with 90% Coverage	20.13		
95% HW Approx. Gamma UTL with 90% Coverage	20.26		

Arsenic

General Statistics

Total Number of Observations	75	Number of Distinct Observations	59
Tolerance Factor	1.566		
Raw Statistics		**Log-Transformed Statistics**	
Minimum	0.25	Minimum	-1.386
Maximum	72	Maximum	4.277
Second Largest	67	Second Largest	4.205
First Quartile	3.625	First Quartile	1.287
Median	11	Median	2.398
Third Quartile	29	Third Quartile	3.367
Mean	19.55	Mean	2.275
SD	20.25	SD	1.351
Coefficient of Variation	1.036		
Skewness	1.109		

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.19	Lilliefors Test Statistic	0.0837
Lilliefors Critical Value	0.102	Lilliefors Critical Value	0.102
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 90% Coverage	51.27	95% UTL with 90% Coverage	80.68
95% UPL (t)	53.51	95% UPL (t)	93.7
90% Percentile (z)	45.51	90% Percentile (z)	54.94
95% Percentile (z)	52.87	95% Percentile (z)	89.74
99% Percentile (z)	66.67	99% Percentile (z)	225.3
Gamma Distribution Test		**Data Distribution Test**	
k star	0.819	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	23.86		
MLE of Mean	19.55		
MLE of Standard Deviation	21.6		
nu star	122.9		

	A-D Test Statistic	0.777	Nonparametric Statistics		
	5% A-D Critical Value	0.788		90% Percentile	53.4
	K-S Test Statistic	0.0915		95% Percentile	61.3
	5% K-S Critical Value	0.107		99% Percentile	68.3
Data appear Gamma Distributed at 5% Significance Level					
Assuming Gamma Distribution			95% UTL with	90% Coverage	61
	90% Percentile	47.27	95% Percentile Bootstrap UTL with	90% Coverage	61
	95% Percentile	62.88	95% BCA Bootstrap UTL with	90% Coverage	59.4
	99% Percentile	99.68		95% UPL	62.6
				95% Chebyshev UPL	108.4
	95% WH Approx. Gamma UPL	62.2		Upper Threshold Limit Based upon IQR	67.06
	95% HW Approx. Gamma UPL	65.99			
95% WH Approx. Gamma UTL with	90% Coverage	57.3			
95% HW Approx. Gamma UTL with	90% Coverage	60.15			

From File: Sheet1.wst

Summary Statistics for Raw Full Dataset

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
Arsenic	592	1.3	313	14.06	11.4	292	17.09	7.984	10.3	163.9	1.215

Percentiles for Raw Full Dataset

Variable	NumObs	5%ile	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Arsenic	592	2.5	2.5	5.216	6.1	11.4	17.1	19.1	26.88	31.05	55.49

General Background Statistics for Full Data Sets

User Selected Options	
From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	592	Number of Distinct Observations	354
Tolerance Factor	1.376		

Raw Statistics		**Log-Transformed Statistics**	
Minimum	1.3	Minimum	0.262
Maximum	313	Maximum	5.746
Second Largest	138	Second Largest	4.927
First Quartile	6.1	First Quartile	1.808
Median	11.4	Median	2.434
Third Quartile	17.1	Third Quartile	2.839
Mean	14.06	Mean	2.319
SD	17.09	SD	0.798
Coefficient of Variation	1.215		
Skewness	10.3		

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.241	Lilliefors Test Statistic	0.0723
Lilliefors Critical Value	0.0364	Lilliefors Critical Value	0.0364
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 90% Coverage	37.58	95% UTL with 90% Coverage	30.49
95% UPL (t)	42.24	95% UPL (t)	37.9
90% Percentile (z)	35.96	90% Percentile (z)	28.28
95% Percentile (z)	42.17	95% Percentile (z)	37.78
99% Percentile (z)	53.82	99% Percentile (z)	65.09
Gamma Distribution Test		**Data Distribution Test**	
k star	1.682	Data do not follow a Discernable Distribution (0.05)	
Theta Star	8.361		
MLE of Mean	14.06		
MLE of Standard Deviation	10.84		
nu star	1991		
A-D Test Statistic	3.943	**Nonparametric Statistics**	
5% A-D Critical Value	0.77	90% Percentile	26.88
K-S Test Statistic	0.0604	95% Percentile	31.05
5% K-S Critical Value	0.0389	99% Percentile	55.49

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution		95% UTL with 90% Coverage	28
90% Percentile	28.5	95% Percentile Bootstrap UTL with 90% Coverage	27.98
95% Percentile	35.27	95% BCA Bootstrap UTL with 90% Coverage	28
99% Percentile	50.44	95% UPL	31.38
		95% Chebyshev UPL	88.62
95% WH Approx. Gamma UPL	34.28	Upper Threshold Limit Based upon IQR	33.6
95% HW Approx. Gamma UPL	34.63		
95% WH Approx. Gamma UTL with 90% Coverage	29.28		
95% HW Approx. Gamma UTL with 90% Coverage	29.26		

From File: Sheet1.wst

Summary Statistics for Raw Full Data Sets

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
Arsenic	27	2.55	25	8.812	8.3	25.73	5.073	4.151	1.251	2.738	0.576
Cobalt	27	5	34.9	12.21	11.7	32.49	5.7	3.113	2.412	9.294	0.467

Percentiles for Raw Full Data Sets

Variable	NumObs	5%ile	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Arsenic	27	2.6	2.63	5.7	5.8	8.3	11.35	11.48	13.56	16.63	22.97
Cobalt	27	5.45	6.16	9.06	9.55	11.7	13.55	14.2	16.82	17.74	30.45

General Background Statistics for Full Data Sets

User Selected Options

From File	Sheet1.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	27	Number of Distinct Observations	24
Tolerance Factor	1.811		

Raw Statistics		**Log-Transformed Statistics**	
Minimum	2.55	Minimum	0.936
Maximum	25	Maximum	3.219
Second Largest	17.2	Second Largest	2.845
First Quartile	5.8	First Quartile	1.758
Median	8.3	Median	2.116
Third Quartile	11.35	Third Quartile	2.429
Mean	8.812	Mean	2.009
SD	5.073	SD	0.616
Coefficient of Variation	0.576		
Skewness	1.251		

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.901	Shapiro Wilk Test Statistic	0.926
Shapiro Wilk Critical Value	0.923	Shapiro Wilk Critical Value	0.923
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 90% Coverage	18	95% UTL with 90% Coverage	22.77
95% UPL (t)	17.62	95% UPL (t)	21.75
90% Percentile (z)	15.31	90% Percentile (z)	16.43
95% Percentile (z)	17.16	95% Percentile (z)	20.55
99% Percentile (z)	20.61	99% Percentile (z)	31.28

Gamma Distribution Test		**Data Distribution Test**	
k star	2.829	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	3.115		
MLE of Mean	8.812		
MLE of Standard Deviation	5.239		
nu star	152.8		
A-D Test Statistic	0.495	**Nonparametric Statistics**	
5% A-D Critical Value	0.751	90% Percentile	13.56
K-S Test Statistic	0.122	95% Percentile	16.63
5% K-S Critical Value	0.169	99% Percentile	22.97

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution			
90% Percentile	15.84	95% UTL with 90% Coverage	17.2
95% Percentile	18.81	95% Percentile Bootstrap UTL with 90% Coverage	20.32
99% Percentile	25.28	95% BCA Bootstrap UTL with 90% Coverage	19.18
		95% UPL	21.88
		95% Chebyshev UPL	31.33
95% WH Approx. Gamma UPL	19.2	Upper Threshold Limit Based upon IQR	19.68
95% HW Approx. Gamma UPL	19.66		
95% WH Approx. Gamma UTL with 90% Coverage	19.84		
95% HW Approx. Gamma UTL with 90% Coverage	20.36		

Cobalt

General Statistics

Total Number of Observations	27	Number of Distinct Observations	25
Tolerance Factor	1.811		

Raw Statistics		Log-Transformed Statistics	
Minimum	5	Minimum	1.609
Maximum	34.9	Maximum	3.552
Second Largest	17.8	Second Largest	2.879
First Quartile	9.55	First Quartile	2.256
Median	11.7	Median	2.46
Third Quartile	13.55	Third Quartile	2.606
Mean	12.21	Mean	2.418
SD	5.7	SD	0.412
Coefficient of Variation	0.467		
Skewness	2.412		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.788	Shapiro Wilk Test Statistic	0.944
Shapiro Wilk Critical Value	0.923	Shapiro Wilk Critical Value	0.923
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	22.53	95% UTL with 90% Coverage	23.65
95% UPL (t)	22.11	95% UPL (t)	22.94
90% Percentile (z)	19.51	90% Percentile (z)	19.02
95% Percentile (z)	21.58	95% Percentile (z)	22.09
99% Percentile (z)	25.47	99% Percentile (z)	29.25

Gamma Distribution Test		Data Distribution Test
k star	5.431	Data appear Gamma Distributed at 5% Significance Level
Theta Star	2.248	
MLE of Mean	12.21	
MLE of Standard Deviation	5.238	
nu star	293.3	

A-D Test Statistic	0.623	**Nonparametric Statistics**	
5% A-D Critical Value	0.747	90% Percentile	16.82
K-S Test Statistic	0.111	95% Percentile	17.74
5% K-S Critical Value	0.168	99% Percentile	30.45
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 90% Coverage	17.8
90% Percentile	19.22	95% Percentile Bootstrap UTL with 90% Coverage	24.64
95% Percentile	21.9	95% BCA Bootstrap UTL with 90% Coverage	24.52
99% Percentile	27.55	95% UPL	28.06
		95% Chebyshev UPL	37.51
95% WH Approx. Gamma UPL	22.15	Upper Threshold Limit Based upon IQR	19.55
95% HW Approx. Gamma UPL	22.29		
95% WH Approx. Gamma UTL with 90% Coverage	22.71		
95% HW Approx. Gamma UTL with 90% Coverage	22.88		